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Aquatics Resources Report

Lover's Canyon Project

Salmon/Scott Ranger District, Klamath National Forest
Siskiyou County, California

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Aquatics Resource Report

Introduction

The purpose of this report is to discuss the effects of the Lover's Canyon Project on aquatic Threatened, Endangered and Candidate species listed for protection under the Endangered Species Act. Threatened, Endangered, and Candidate species proposed for listing are designated by the U.S. Fish and Wildlife Service (FWS) and National Marine Fisheries Service (NMFS) under authority of the Endangered Species Act (Act) of 1973, as amended. The Act requires federal agencies insure that any action authorized, funded, or carried out by such agency is not likely to jeopardize the continued existence of any endangered or threatened species or result in the destruction or adverse modification of those species habitat. Additionally, Essential Fish Habitat (EFH) consultation occurs under of the Magnuson-Stevens Fishery Conservation and Management Act.

This report will also discuss the effect of the project on aquatic Forest Service Sensitive and Management Indicator Species. Federal laws and direction applicable to Sensitive species include the National Forest Management Act (NFMA, 2000) and Forest Service Manual (USDA, Forest Service, 1995, FSM 2670). Sensitive species are classified at the Region level, and management indicator species by the Forest. The Klamath Land and Resource Management Plan (LRMP) directs the Forest to (1) "maintain or improve habitat for aquatic species, especially TE&S" and (2) "maintain suitable fish habitat that will support well distributed, viable populations of native and desirable non-native fish". To this end, the Forest has adopted an aquatic conservation strategy, including the designation of buffered Riparian Reserves and Standards and Guidelines to maintain habitat for aquatic species (USFS 1995).

Methodology

Different sets of Threatened, Endangered, and Candidate species are managed by the FWS and NMFS. A FWS species list was obtained online from the agency IPaC portal website on March 3, 2017 (FWS 2017). No protocol exists to acquire a Project-specific NMFS list at this time; and email discussion with the local NMFS representative confirmed the above sources to provide current listing information for species managed by NMFS (D. Flickinger, pers. comm.). Species considered as Forest Service Sensitive were compiled by the Forest Service Pacific Southwest Regional Office. These lists were used as a basis for determining which aquatic species were to be considered in this specialist report. See **Table 1** for a summary. Terrestrial and semi-aquatic species, including amphibians, are analyzed in the Wildlife report.

The only Threatened or Endangered fish in the analysis area is the Southern Oregon/Northern California Coasts Coho salmon (*Oncorhynchus kisutch*), including Critical Habitat. Sensitive fish species for the Klamath National Forest in the Project are the Upper Klamath-Trinity Rivers Chinook (*Oncorhynchus tshawytscha*), Klamath Mountains Province Steelhead (*Oncorhynchus mykiss*), Klamath River lamprey (*Entosphenus similis*), and Pacific lamprey (*Entosphenus tridentatus*). Both steelhead and resident rainbow trout (*Oncorhynchus mykiss*) are management indicator species in the Forest Plan. Additionally, Essential Fish Habitat designation is associated with Coho salmon and Chinook salmon. The NMFS has requested action agencies, including the KNF, to consider project impacts on species preyed upon by ESA-listed killer whale (*Orcinus*

orca). For this project, the relevant species would be the three anadromous salmonids introduced for analysis. See **Table 1** for a summary of aquatic Project species. Since analyzed fish species have overlapping needs and habitat, the same Indicators are used to indicate effects to all analysis species. These Indicators are outlined in the following section.

Table 1. Summary of analysis species, including status of each.

		Endangered	**Threatened**	**Forest Sensitive**	**MIS**	**Critical Habitat**	**Essential Fish Habitat**
Salmonids							
Coho Salmon (Southern Oregon/Northern California Coasts)	*Oncorhynchus kisutch*		X			X	X
Chinook Salmon (Spring/Fall runs) (Upper Klamath-Trinity Rivers)	*Oncorhynchus tshawytscha*			X			X
Steelhead Trout (Klamath Mountains Province)	*Oncorhynchus mykiss*			X	X		
Rainbow Trout	*Oncorhynchus mykiss*				X		
Lamprey							
Pacific Lamprey	*Entosphenus tridentatus*			X			
Klamath River Lamprey	*Entosphenus similis*			X			
Mammals							
Killer Whale (Orca) (Southern Resident)	*Orcinus orca*	X				X	

The Project site was visited multiple times by Maija Meneks (Fish Biologist – USFS) between 2013 and 2016 to examine aquatic resources potentially affected by proposed Project activities.

Data sources used to determine historic/current anadromous and resident salmonid distribution and habitat condition included:

1. Forest GIS layers
2. CalFish on-line database
3. Habitat/fish presence surveys performed by Forest Service personnel or contractors

This information, as well as scientific literature, field review, Project watershed and geology reports, and best professional judgment, was the basis for evaluating impacts to aquatic resources in the Project area.

Information specific to the biological requirements of species under consideration in this document is found in **Appendix B**.

Analysis Indicators

The analysis of the potential effects to fish and their habitat is organized by direct and indirect effects and by effects to seventeen Indicators of anadromous fish habitat conditions (**Table 7**). The Indicators originate from the "Analytical Process for Developing Biological Assessments for Federal Actions Affecting Fish within the Northwest Forest Plan Area" (USDI, USDA, and NOAA 2004). Further discussion of Indicators is found in **Appendix C**. Effects of project elements to an Indicator may be neutral (no effect), discountable (extremely unlikely to occur), insignificant (effects are not able to be meaningfully measured, detected, or evaluated), or significant (effects able to be measured). Furthermore, effects may be either positive or negative. After the appropriate Indicators have been evaluated, the resulting information is used to determine overall effects on aquatic species, including Coho Critical Habitat and Essential Fish Habitat.

Although the methodology for effects analysis only technically applies to anadromous fish within the Project area (e.g., Coho, Chinook, and steelhead), for this report it is also used for resident rainbow trout to ensure a consistent assessment of fish species; and indirect effects to anadromous fish will serve as a proxy for lamprey. Additionally, Indicators are used to assess the existing environment of anadromous systems, with each Indicator labeled as to if it is "Properly Functioning," "Functioning-At-Risk," or "Not Properly Functioning" for each stream (**Appendix C, D**).

Analysis Indicators and Locations Excluded From Further Analysis

The following Indicators are to be excluded from analysis because Project components will not affect anadromous/resident fish or their habitat:

Chemical Contamination and Nutrients – Nutrient enrichment is not expected to change in area streams as a result of the actions proposed in this Project, and no point sources are known. Avoidance of Riparian Reserves, restriction of Project activities in Riparian Reserves, and other Project BMPs will preclude the possibility of any contamination being mobilized into streams within the Project. No fertilizers will be used.

Physical Barriers –There are human-made barriers upon South Fork Kelsey Creek, which is within the Project area footprint. South Fork Kelsey Creek supports resident rainbow trout, but not anadromous species. Removal or modification of these barriers for fish passage is outside the scope of this Project. No new barriers will be built as a consequence of this Project.

Pool Frequency and Quality — Potential project related changes to the sediment regime are described by the Substrate Indicator under Indirect Effects. There will be no meaningful change in sediment input and stream flows in fish bearing reaches (USFS 2016b), and therefore no effect to pool frequency or quality.

Off-Channel Habitat – Nearly all Project area streams are on steep slopes with no off-channel habitat. Project activities are not adjacent to where off-channel or side channel habitat is present (lower Canyon Creek, lower Kelsey Creek, Scott River), thus there will be no mechanism to affect off-channel habitat.

Refugia – This Indicator is a synthesis of presence and degree of functionality of habitat elements available for fish throughout their life history. There will be no change in the ability of

riparian or instream habitat elements to maintain present fish populations, nor will connectivity between local/upstream and distal/downstream fish populations be altered.

Width/Depth Ratio – Potential project related changes to sediment composition are described by the Substrate Indicator under Indirect Effects. There will be no measurable change in sediment input in fish bearing reaches and, thus, no change in channel morphology (USFS 2016b).

Streambank Condition – While some Project units include activities which will occur within Riparian Reserves, they are not inclusive the streambanks of fish-occupied systems. Drafting will use existing access points, resulting in no bank modification. Project design features preclude impacts to streambanks.

Floodplain Connectivity – As peak/base flows are expected to maintain proper functioning, flow access to upper banks will continue to occur at expected rates. Floodplains are generally not a significant component in mountainous channel types (Rosgen A and B) such as those present in most of the (non-anadromous) fish-bearing reaches of the Project footprint. Additionally, the primary floodplain habitat within the Project area is immediately adjacent to lower Canyon Creek, lower Kelsey Creek, and Scott River. Ground disturbing Project activities are not planned within the floodplains of these areas.

Road Density/Location – No new system roads will be constructed. One mile of temporary road will be placed on existing (closed to public use) roadbeds, then hydrologically stabilized after the project. Potential effects related to temporary roads and landings are discussed in Indirect Effects for the Drainage Network Indicator.

The following 7th-field watersheds which have no fish resources, and thus no chance for exposure, are not carried further in the analysis:

- Deep Creek-Scott River and Isinglass Creek-Scott River – These two 7th-field drainages are "compound watersheds", meaning they incorporate multiple unconnected drainages to the either bank of Scott River in the larger watershed boundary. Within the Project footprint, all streams associated with the respective watersheds are fishless.
    - Although Scott River is part of these 7th-field watersheds and does contain aquatic resources, it will be discussed separately on the 5th-field scale.

An exception to exclusion for the above watersheds will occur for Indicators which are typically analyzed and discussed in respect to the landscape scale, including relevant Habitat-Watershed Condition Indicators: e.g., disturbance history/regime, drainage network, and similar.

Summary of Analysis Indicators and Locations Retained for Analysis

Indicators

The following Indicators are potentially affected by the Project and will undergo further discussion:

- Temperature
- Sediment/Substrate
- Turbidity
- Large Woody Debris
- Disturbance History/Regime

- Peak/Base Flows
- Drainage Network
- Riparian Reserves

Site Scale
Water drafting from Boulder Creek, Canyon Creek, and SF Kelsey Creek has the potential to directly affect fish at the site level.

7th-Field Watershed Scale
Boulder Creek – Boulder Creek
Boulder Creek is the principle stream of this 7th-field watershed within the Project area. Resident rainbow trout are found in Boulder Creek; and the thermal refugia with Scott River supports Coho, Chinook, and steelhead juveniles during periods of elevated mainstem water temperatures.

Lower Canyon Creek – Canyon Creek
Canyon Creek is the principle stream of this 7th-field watershed within the Project area. Coho, Chinook, steelhead, and rainbow trout are found in Canyon Creek; and the potential exists for lamprey spawning habitat. Additionally, the confluence area of Canyon Creek is a thermal refugia for Scott River salmonids.

While two tributaries to Canyon Creek are within the Project footprint, they are not included in this analysis. Deep Lake Creek has resident rainbow trout, but no project activities will occur within the subdrainage. Second Valley Creek is considered to be fishless; and while rainbow trout have been observed within the first 150 feet of the stream, there are many barriers, the gradient is steep, and, thus, these fish are considered to be congruent with the Canyon Creek population.

Upper Canyon Creek – Canyon Creek
Canyon Creek is the principle stream of this 7th-field watershed within the Project area. This portion of the creek is above the upstream limit to anadromy and only resident rainbow trout are present. Other fish-bearing sub-drainages within this watershed are outside the Project footprint and the associated area of potential effect.

North Fork Kelsey Creek – Kelsey Creek
Kelsey Creek is the principle stream of this 7th-field watershed within the Project area. This portion of the creek is above the upstream limit to anadromy and only resident rainbow trout are present.

South Fork Kelsey Creek – Kelsey Creek, South Fork Kelsey Creek
Kelsey Creek is the principle stream of this 7th-field watershed within the Project area. Coho, Chinook, steelhead, and rainbow trout are found in Kelsey Creek; and the potential exists for lamprey spawning habitat. Additionally, the confluence area of Kelsey Creek is a thermal refugia for Scott River salmonids.

South Fork Kelsey Creek is a tributary to Kelsey Creek within the Project area. This portion of the creek is above the upstream limit to anadromy and only resident rainbow trout are present.

5th-Field Watershed Scale
Lower Scott River – Scott River
All fish species of interest – Coho, Chinook, steelhead, rainbow trout, lamprey – are present in Scott River. his scale considers (1) impacts on the landscape level and (2) potential distal effects

to the mainstem Scott River originating from streams on the 7th-field scale, including otherwise excluded watersheds such as Deep Creek-Scott River and Isinglass Creek-Scott River. Because the unnamed streams in these latter 7th-field watersheds do not directly support fish resources, it was determined that contribution to Project effects was best discussed in relation to the Scott River, where fish are present.

All ground disturbing Project activities are located outside the Scott River Riparian Reserve.

Measures (for Analysis Indicators)

Temperature

This Indicator is rated by stream temperature, and the expected change from the existing condition due to Project activities (**Appendices C, D**).

Sediment/Substrate

This Indicator is rated by percentage of substrate composition of finer material. Considered data can include composition of surface and subsurface of non-pool units, as well as volume of pools filled with fines. Where no or limited survey data is available, evaluation may utilize CWE (USLE/GEO) models and professional judgment (**Appendices C, D**). Details about the CWE models and assumptions can be found in the Hydrology Report and the Geology Report.

Sediment in streams is a part of the natural geological process; and certain erosive geologies, such as granitic soils, can impart a high amount of fines to a stream system even from Wilderness locales. As a local example, severe thunderstorms in 2015 over recently burned areas on the Klamath National Forest delivered a large amount of sediment to area streams (USFS 2015a). It is when management activities upon the landscape increase incoming sediment flux within a drainage such that it is higher than normal background processes that human-induced impact to aquatic resources begin to occur. Depending upon the scale considered, effects may be highly localized (i.e., at the confluence of two streams) or more diffuse (i.e., multiple miles of increased spawning bed embeddedness). Most activities described for the Project either occur in the uplands outside of defined Riparian Reserve buffer areas, are low impact with little or no ground disturbance, or, when they do occur in Riparian Reserve are distant from fish-occupied waters, resulting in no more than small, localized impacts.

Parsons, *et al*. (2006a) summarizes the relationship of erosion and sediment delivery to streams, starting with the concept that most sediment transported by streams is delivered from the bed and banks of channels and alluvial deposits within the catchment. Therefore, except where a landslide intersects a live stream channel or other similar uncommon circumstances, most sediment must travel overland before it can contribute to the stream substrate environment. Movement of fine sediment, both overland *and* instream, is dependent upon factors such as slope gradient and length, roughness, and precipitation/water; and even under ideal modeled or experimental circumstances, most sediment does not move very far from its source. For instance, Parsons, *et al.* (2006b) performed a series of controlled experiments, finding maximum sediment yield 7 m from a source; and this distance is consistent with other models, experiments, and observations (Parsons, *et al*. 2006a). Beyond this point, sediment yield quickly declines.

In the case of timber harvest, increased sediment input to streams is one of many potential impacts to aquatic biota (Chamberlin, *et al*. 1991). However the distance soil moves is short, the use of Best Management Practices (BMPs) and management actions that minimize soil and litter

disturbance are effective in containing, controlling, and minimizing overland flow of water and sediment (Edwards and Willard 2010; Aust and Blinn 2004).

Vegetated riparian buffers as small as 10 meters can be effective in decreasing sediment from upland timber harvest activities to levels difficult to distinguish from background variability (Clinton 2011). However, while smaller buffers (i.e., 15 meters or less) may be sufficient to preserve physical and chemical stream characteristics, larger widths are required to maintain biological components (Castelle, *et al*. 1994). In regards to effectively filtering sediment from upland management activities, 30 m is a general recommended width, although other habitat components – noise reduction, stream shading, large woody debris recruitment/retention – should also be taken into account, as well as particular resource needs of individual species (Castelle, *et al*. 1994). Effective buffer width at any given location will vary dependent upon the landscape and upslope management activity, but eventually stream protection efficacy will plateau, after which disproportionately large buffer widths are required to yield ever small increments in sediment removal or improved biological response (Castelle, *et al*. 1994; Wong and McCuen 1982).

Turbidity

This Indicator is rated by professional judgment following observation of conditions after high water events, amount of substrate fines, CWE models (USLE/GEO), and condition of Riparian Reserves (**Appendices C, D**). In addition, the distance to fish habitat and the likelihood of activities to introduce fine sediment into fish-bearing streams will also be incorporated into the effects analysis.

Turbidity describes suspended sediment in the water column. It is generally composed of very small particles like silts because larger material is difficult to keep suspended except at high flows (Swanston 1991). Because a degree of turbidity is natural in stream systems, often observed during spring run-off and storm events, fish are adapted to it (Bjornn and Reiser 1991). Outside the laboratory environment, chronic and elevated levels of turbidity considered detrimental to aquatic organisms only occur following catastrophic natural incidents such as large landslides or extensive wildfires, or where human activities provide an extensive raw surface available for continuous stream erosion (Meehan 1991; Neary, *et al*. 2008).

Instream activities produce both short- and long-term effects in regards to turbidity/suspended sediment production. A conceptual model includes two main phases: (1) a pulse of suspended sediment associated with construction activities, and (2) continued erosion of fine particles from disturbed banks until such time that vegetation stabilizes the soil (Sear, *et al*. 1998). The initial suspended sediment release is expected to be short-term, amount of suspended sediment rapidly dropping to pre-construction levels both in time and space (Sear, *et al*. 1998; Madej 2001; Brown 2002; Foltz and Yanosek 2005). For example, a study commissioned by the Environmental Protection Agency found that turbidity caused by instream suction dredging returned to acceptable water quality levels within 250 feet; and no discernible turbidity release occurred when dredges were not operating (Royer, *et al*. 1999). Observations of channel dewatering activities have confirmed that turbidity drops within hours after instream work has been completed (D. Flickinger, pers. comm.); and the KNF programmatic Facilities Maintenance and Watershed Restoration Biological Assessment included consultation upon minor instream activities such as culvert replacement, determining that turbidity was undetectable beyond a distance of 300 feet (USFS 2004). Residual increases over background may remain, however,

due to erosion of exposed surfaces and resuspension of settled matter (Brown 2002; Foltz and Yanosek 2005). Most erosion occurs in the first few floods following in-channel work, with long-term stabilization occurring once appropriate vegetation grows (Madej 2001; Sear, *et al*. 1998).

Large Woody Debris

This Indicator is rated using amount of "large wood" per linear length of stream; and is only applicable in 3rd or larger order stream systems (**Appendix C, D**). The Northwest Forest Plan and KNF Land Resource Management Plan (page #4-143) offer guidelines as to an acceptable amount of wood, as well as provide definitions of "large wood". If professional judgment concludes guidelines are inadequate or do not capture the nature of the system under consideration, channel width and potential of the site to produce and retain woody debris may be used. Potential for future large woody debris recruitment in both short- and long-term should also be included in rating the Indicator. Recruitment effects will be determined using the likelihood of the removal of standing trees that have a high probability of becoming large woody debris in the stream channel based on professional judgment and scientific literature.

For large woody debris to affect fish, it must (1) recruit to the stream and (2) be transported to fish-occupied waters. Ninety percent of wood recruitment for systems similar to the Project area tends to occur within 15 to 35 meters of the stream (Benda and Bigelow 2011); and one model suggests that a buffer width which is 2/3 the stand-average tree height is sufficient to maintain 95 percent of wood recruitment (Benda, *et al.* 2015). While debris flows can be an important vector in the large-scale exportation of wood from headwaters to fish-bearing reaches, such are relatively infrequent in nature (May and Gresswell 2003, 2004) and may be catastrophic in extent, scouring channels and banks. Most non-debris-flow wood transport in small streams tends to average a couple hundred meters over the lifetime of the wood, with the lower portion of the headwaters therefore the most important in moving wood to fish-bearing areas (Benda and Bigelow 2011).

Disturbance History/Regime

This Indicator is primarily rated using CWE (ERA/USLE/GEO) models. If professional judgment concludes that these models are not fully capturing disturbance risk, road density and location, current impacts from past stand-replacing timber harvest and wildfire, fire regime, vegetation regime, and development on private property may also be considered (**Appendix C, D**).

The ERA, USLE, and GEO models track various aspects of human and natural impacts upon the landscape and geologic environment. ERA ("Equivalent Roaded Area") provides an accounting system for tracking disturbances that affect watershed processes, in particular changes in peak runoff flows influenced by ground disturbing activities; USLE ("Universal Soil Loss Equation") tracks surface erosion and sediment delivery in the first year following project completion; and GEO estimates sediment delivery from mass wasting (i.e., landslide events) for the first decade after project completion. A threshold of "1" generally indicates an elevated risk of impact from a given model. This is not the point at which significant effects occur, but a yellow flag indicating that additional impacts need to be considered for resource degradation.

Peak/Base Flows

For watershed-level, this Indicator is rated using elements of ERA, road density, vegetation and Riparian Reserve condition, and other associated components (**Appendix C, D**). Any potential effects to flows due to a site-specific Project element are considered individually.

Drainage Network

This Indicator is rated by increase/decrease in drainage network as related to roads, ditches, and other similar structures (**Appendix C, D**).

The drainage network can be roughly considered in light of road density, number of road crossings, and overall ERA, but primarily it is an aspect of how "connected" an artificial drainage feature (road, ditch, or other element) is to the natural hydrologic system. For instance, a road on a ridgetop will have less impact to the drainage network than a road adjacent a stream or one crossing a stream channel. The more connected a road is to the drainage network, the more it potentially influences hydrological regime and inputs of sediment to the stream system. Additionally, the gullies and ditches associated with roads can effectively increase the drainage length and overall hydrologic connectivity within a basin, with more water flowing through channels instead of via normal subsurface or overland routes. Such connectivity can impact local hydrologic regimes (Wemple, *et al*. 1996; Croke and Mockler 2001). The connectivity of temporary roads is determined using field review, hillslope placement and distance to a stream channel.

Riparian Reserves

This Indicator is a consideration of the riparian environs, and extending into the near uplands. It is rated as a synthesis of shade; large woody debris recruitment; disturbance, roading, and other impacts to the Riparian Reserve management zone (**Appendix C, D**).

Spatial and Temporal Bounding of Analysis Area

The analysis area for aquatic resources includes effects at the site-specific and watershed-scale extent.

Watersheds utilized in the analysis are at the 5th- and 7th-field level.

Site-specific analysis discussion will focus on water drafting within the range of anadromous and resident fish. For the remainder of the Project area, Project components are outside the distribution of analysis species, habitat is not present, and/or distance to occupied/suitable habitat is too distant for an effect to occur.

Temporal analysis timeframe includes effects during implementation, short-term effects expected to occur within the first year following implementation, and long-term effects (greater than one year).

Affected Environment

The Lover's Canyon Project is situated west of the town on Fort Jones and south of the Scott Bar community (**Map 1**). The Project is located south of the Scott River, in the general vicinity of Indian Scott Campground, and within the non-Wilderness portions of Boulder Creek, Canyon Creek, and Kelsey Creek drainages. Several fish-bearing streams are potentially affected by the Project: Scott River, Boulder Creek, Canyon Creek, and Kelsey Creek (including SF Kelsey Creek). Additionally, there are many fishless drainages (intermittent and perennial) within the Project area. Project footprint elevation is approximately 2,240 to 6,700 feet.

The Project will occur within the following 5th-field and 7th-field watersheds:

- Lower Scott River: 1801020806
    - Boulder Creek: 18010208060202
    - Deep Creek-Scott River: 18010208060402
    - Isinglass Creek-Scott River: 18010208060203
    - Lower Canyon Creek: 18010208060103
    - North Fork Kelsey Creek: 18010208060301
    - South Fork Kelsey Creek: 18010208060302
    - Upper Canyon Creek: 18010208060201

Legal location of Project footprint include: T.43N., R.11W., Sections 1-9; T.43N., R.12W., Section 1; T.44N., R.11W., Sections 19-21, 25-36; and T.44N., R.12W., Sections 24, 25, 36 (Mount Diablo Meridian).

The Scott River is a major tributary to the middle Klamath River system, with a drainage area of approximately 800 square miles. Major ranges boarding the watershed include Marble Mountains, Salmon Mountains, Scott Bar Mountains, and Scott Mountains. Agriculture, timber harvest, gold mining, roads, recreation, wildfire, and floods are some of the primary past and present influences with in the drainages, with private land comprising about two-thirds of the ownership. Coho and Chinook salmon, steelhead, resident rainbow trout, and lamprey are present, with the upstream limits of each species restricted by barriers, gradient, discharge, and/or stream size. Chinook and Coho spawning have been observed in the river segment adjacent the Project area; and lamprey rearing areas are recorded to be present.

Canyon Creek is a fourth-order perennial tributary of the Scott River. Generally flowing southeast, it drains the north side of the Marble Mountain ridge, including prominent features such as Marble Mountain, Black Marble Mountain, Boulder Peak, Red Mountain, and Box Camp Mountain. Except for about 1 mile of creek in the lower portion of the drainage, ownership with the watershed is Forest Service. Canyon Creek has several named perennial tributaries – Second Valley Creek, Deep Lake Creek, and Red Rock Creek – as well as multiple lakes, ponds, and meadows scattered throughout its various headwater drainages. Past and present influences within the drainage include timber harvest, roads, recreation, grazing, mining, water diversion, wildfire, and flood. An extensive trail system is present, and one of the most popular Forest trailheads – Lovers Camp – is a gateway to Wilderness destinations such as Sky High Lakes and Marble Valley. Coho, Chinook, steelhead, and rainbow trout are present in the creek, with the upstream limits of each species (e.g., approx. 1.3 miles upstream from the mouth for SONCC Coho salmon and Chinook) restricted by gradient, discharge, stream size, and/or barriers.

Kelsey Creek is a third-order perennial tributary of the Scott River. The creek generally flows east and southeast, it drains ridges and peaks on the northern end of the Marble Mountains, including Cayenne Ridge and Box Camp Mountain. Other than a small mid-slope parcel of private property, Kelsey Creek drainage ownership is Forest Service. Named perennial tributaries include South Fork Kelsey Creek, North Fork Kelsey Creek, and Packers Valley Creek; and two lakes – Paradise Lake, Turk Lake – are present in the extreme headwaters. Past and present influence within the drainage include timber harvest, roads, recreation, grazing, mining, seasonal recreational residences, wildfire, and flood. A historic mining site – Kelsey Camp – is found at the mouth, adjacent Scott River; and in this same area, an artificial salmonid spawning channel was built in the 1980s, but it is currently inactive and in the decommissioning process. Several popular trailheads are located in the Kelsey Creek drainage to access Wilderness destinations. Coho, Chinook, steelhead, and rainbow trout are present in lower mainstem Kelsey Creek, with the upper limit of anadromy a series of unnamed waterfalls located ~0.65 miles upstream from the mouth. Above this point, including South Fork Kelsey Creek, only resident rainbow trout are present (**Photos 1a and 1b**). Above this point, including South Fork Kelsey Creek, only resident rainbow trout are present.

Photo 1a. Kelsey Creek - lower waterfall. Height is about 6 feet. Considered to be a Coho and Chinook barrier.

Photo 1b. Kelsey Creek - upper waterfall. Total height is about 13 feet. Steelhead barrier and upstream limit of anadromy.

Boulder Creek is a second-order perennial tributary of the Scott River. Flowing south, it originates from Lower Wright Lake on the northeast flank of Boulder Peak within the Marble Mountains Wilderness. Except for the lowermost ~0.2 mile, ownership within the drainage is entirely Forest Service. In addition to Lower Wright Lake, the extreme headwaters include Upper Wright Lake, with surface connection to the main Boulder Creek basin by this lake normally seasonal. Past and present influences within the drainage include timber harvest, roads, grazing, water diversion, residential use, recreation, and flood. Resident rainbow trout are present. Barriers at the mouth, including steep gradient and waterfalls/cascades, prevent access by both juvenile and adult anadromous fish.

All three Project area tributaries to Scott River as discussed above were found to function as thermal refugia during 2005 surveys (USFS 2005). Coho, Chinook, and steelhead/rainbow trout have all been observed congregating in the cool-water outflows when summer water temperatures are elevated in the Scott River.

Of particular interest, many of the streams in the Project area experienced extensive scouring during the 1964 and 1997 flood events. Flood impacts were likely exacerbated due to historic mining practices, fire, timber harvest, and roading. Satellite and aerial imagery, such as that available from services like GoogleEarth, which date from the years following the 1997 event clearly show areas of channel scour in Kelsey Creek, as well as track long-term recovery of all Project area drainages from the earlier flood event. On the ground, signs of flood impact and on-going system adjustment include areas of aggradation and downcutting, streambanks comprised of cobbles and other coarse material (i.e., lacking a developed soil covering), riparian forest in early- to mid-seral stage, and general lack of woody debris (because it was transported out of the system during the floods). Not all streams were affected equally, and some systems, or portions within a larger drainage, may have experienced little to no impact.

Composition of riparian vegetation within the Project area is very diverse, reflecting differences between locations in regard to elevation, slope aspect, soil character, timber harvest, wildfire history, flooding, and local hydrologic condition. Large-scale scouring by recent floods, especially 1964 and 1997, as referenced above, has generally reset the riparian conditions to early- to mid-seral stages in many tributaries, with regrowth retarded due to banks being reduced to cobbles and other coarse materials. Alder, big-leaf maple, cottonwood, willow, and dogwood are common riparian species. Drier areas within riparian corridors may also include upland species such as oak, Douglas-fir, western red-cedar, and other conifers. Several small (unnamed) meadows are present within the Project footprint, the largest of which is located within the Canyon Creek drainage adjacent to Forest Road 44N54 and just north of its junction with Forest Road 43N45.

Width of the riparian zone is varied and heavily dependent upon persistence of water (surface and subsurface) in relation to the stream channel and microclimate conditions. In drier locations, such as ephemerals and short-season intermittents, the riparian zone may extend less than five feet from the channel margin and classic riparian vegetation such as alder or willow is not continuous. The contrast between riparian and uplands is obvious/stark. On the other hand, wetter systems with a developed floodplain, such as along mainstem Scott River, have a much wider area where groundwater influence allows growth of species which require proximity to water. In these latter systems, the transition of "riparian" to "upland" is much more subtle, and may be difficult to definitively delineate. A stream "riparian zone", where hydrophilic vegetation predominates, contrasts with the "Riparian Reserve" defined in the KNF Land Resource Management Plan, the latter of which is a standard-width derived land allocation whose purpose is to serve as a planning tool. The width of a "Riparian Reserve" is generally greater than a stream's true riparian zone, and often includes true upland vegetation within it.

As with the riparian zone, the uplands are varied when considered across the landscape area of the Project. Due to the general north and west aspect of Project topography, conifers such as Douglas-fir, pine species, and western red-cedar dominate, although there are also locations with oak and other hardwood species. Past timber harvest activities upon Forest Service land in the Project area created large clear-cuts, many of which were subsequently replanted as monoculture conifer plantations. The exact species composition of local vegetation is dependent on elevation, aspect, soils (both natural and as affected by historic mining practices), timber harvest, fire, and microclimate.

Appendix B includes specifics in regards to biology of analysis species, as well as survey records. In summary (**Maps 1 and 3**; **Tables 2 and 3**):

Table 2. Summary of actual and potential occupancy by analysis species of creeks/rivers within 7th- and 5th-field watersheds, including thermal refugia.

Species	7th-Field				5th-Field
	Boulder Creek	Canyon Creek	Kelsey Creek	SF Kelsey Creek	Scott River
Coho	T	X, T	X, T		X
Chinook	T	X, T	X, T		X
Steelhead	T	X, T	X, T		X
Resident Rainbow Trout	X	X	X	X	X
Pacific Lamprey		P	P		X
Klamath River Lamprey		P	P		X

X - confirmed present
P - potential presence
T - thermal refugia

- Lamprey species – Both lamprey species are confirmed to be present in the Scott River mainstem via the California Department of Fish and Wildlife rotary screw trap near Scott Bar, as well as direct observation. Specific distribution of lamprey within Project tributaries is unknown. While the tributaries do not appear to support appropriate rearing habitat, spawning habitat may be present in Canyon Creek and Kelsey Creek. At this time, potentially suitable habitat is considered to be congruent with anadromous fish species. See **Appendix B** for additional information on lamprey within the Project area.
- Juveniles of anadromous salmonid species have been observed using thermal refugias present in the Scott River at the mouth of Boulder Creek, Canyon Creek, and Kelsey Creek (**Table 2**). In the case of Boulder Creek, steep gradient and other barriers at the mouth prevent upstream occupancy.

Table 3. Summary of closest distance between Project activities and anadromous fish and their habitat (including critical habitat) – 7th- and 5th-field watersheds. Distance is miles unless otherwise indicated to be feet (by a ' symbol). Presented for Alternative 2 only.

Watershed	Stream Name	Distance to Habitat occupied by Coho and CH (miles)	Distance to Habitat occupied by Steelhead Trout (miles)	Distance to Habitat occupied by Chinook (miles)
7th Field Watershed(s)				
Boulder Creek	Boulder Creek	*Closest activity same for all species - focus on thermal refugia*[1]		
		0.2 - Fuel break[W] 0.25 - Unit 524-054 (skyline)[O, W] 0.8 - Unit 524-009 (PCT/Mastication)[O, W]	0.2 - Underburn[W] 1.2 - Legacy treatments[O, W] 0.8 - Water drafting[W]	
Deep Creek-Scott River	Scott River	*Closest activity same for all species*		
		<200' - Fuel break[O] ~350' - Unit 526-085 (skyline)[O] 0.15 - Unit 526-126 (PCT)[W]	0.15 - Legacy treatments[W] ~350' - Underburn[O]	
Isenglass Creek-Scott River	Scott River	*Closest activity same for all species*		
		<100' - Fuel break[O] 0.2 - Unit 524-053 (tractor)[O] 0.15 - Unit 524-038 (PCT/Mastication)[O]	0.1 - Legacy treatments[O] ~0.2 - Underburn[O]	
Lower Canyon Creek	Canyon Creek	*Closest activity same for all species*		
		0.0 - Fuel break ~350' - Unit 524-054 (skyline)[O] ~300' - Unit 526-063 (PCT)[O]	0.0 - Underburn 0.15 - Legacy treatments[W] 0.0 - Water drafting	
Upper Canyon Creek	Canyon Creek[2]	*No anadromous species in Upper Canyon Creek watershed*		
NF Kelsey Creek	Kelsey Creek[2]	*No anadromous species in NF Kelsey Creek watershed*		
SF Kelsey Creek	Kelsey Creek[2] SF Kelsey Creek[2]	*Closest activity same for all species*		
		0.0 - Fuel break ~2.3 - Unit 527-150 (skyline)[W]	~0.1 - Unit 527-122 (PCT)[O] 2.7 - Legacy treatments[W]	
5th Field Watershed(s)				
Lower Scott River	Scott River	*Closest activity same for all species*		
		<100' - Fuel break[O] ~350' - Unit 526-085 (skyline)[O] 0.15 - Unit 526-126 (PCT)[W]	~350' - Underburn[O] ~200' - Water drafting[W] 0.1 - Legacy treatments[O]	

[1]Salmonid juveniles have been observed at the mouth in association with the Boulder Creek thermal refugia. Because anadromous species cannot enter Boulder Creek due to gradient and physical barriers, Project effects will be considered with respect to potential impact to this refugial area only.

[2]Portions of Canyon and Kelsey Creek located upstream from barriers to anadromy - resident rainbow trout occupancy only.

Primary pathway of activity to affect target salmonid habitat: [O]Overland; [W]Waterway/Channel

*If distance is zero and there is no pathway provided, then there is no setback between target habitat and the activity.

--Existing Conditions – Analysis Indicators--

Only Indicators potentially affected by the Project and, therefore, introduced in the "Methodology" section, are further discussed here prior to analysis within "Environmental Consequences". Indicators are generally applied only to anadromous systems. A summary of all discussed Indicators is presented in **Table 7**. See **Appendix D** for a list of remaining Indicators and their relationship to baseline conditions.

Temperature

The Scott River drainage is 303(d) listed under the Clean Water Act as impaired for water temperature. Water temperature on the mainstem is widely recognized as a limiting factor to salmonid production in this watershed (NOAA 2014). Within the project area, recent stream temperature data is available for Boulder Creek, Canyon Creek, Kelsey Creek, and Scott River.

Canyon Creek and **Kelsey Creek** have fish habitat, including Coho Critical Habitat, within Project boundaries. Although **Boulder Creek** only supports resident rainbow trout, its confluence outflow at Scott River is an important cool-water thermal refugia area for resident and anadromous fish. Canyon Creek is labeled a "reference" system in regards to temperature monitoring; and Boulder Creek and Kelsey Creek are "managed" systems. All creeks meet the criteria for "Properly Functioning" under the AP framework. Stream temperature monitoring by the KNF (starting 2010), as required by the North California Regional Water Quality Control Board for TMDL compliance, has determined both Canyon Creek and Boulder Creek meet state maximum weekly water temperature threshold of 16^0C to support beneficial uses for core juvenile salmonid rearing; and Kelsey Creek exceeds the threshold some years (unpub. data). However, stream shade measured in 2011 showed existing percentage of shade in all three watersheds to have no or minimal human-caused reductions (USFS 2012). Therefore, shade in these drainages is considered to be in a natural condition, with the caveat that maximum potential may not be reached at present due to recovery from past flood scour and/or wildland fire. There is evidence that many sites on the KNF where temperatures are observed to be above the State beneficial use threshold for juvenile salmonids is due to natural conditions, with temperatures in 15 out of 20 reference (non-managed) streams exceeding 16^0C (USFS 2012). Due to the KNF temperature monitoring program, Canyon Creek) was removed from the State 303(d) list in 2014 (Water Board 2014). Although other Project streams, such as Boulder Creek, may exhibit a sufficiently low temperature to consistently meet state TMDL requirements, they are considered to be "managed" and insufficient data has been collected at this time to propose them for removal from the 303(d) list.

Scott River typically has elevated summer water temperatures, potentially lethal to salmonids, due to cumulative human impacts of agriculture, surface water diversion, clearing of riparian vegetation, and other factors. The Scott River is "Not Properly Functioning" under the AP framework. During the warm summer months when water temperatures in the Scott River approach or exceed 20^0C, anadromous and resident fish rely upon cooler water habitat within tributary creeks and their confluence zones (thermal refugia). Project area creeks of Boulder Creek, Canyon Creek, and Kelsey Creek provide thermal refugia that juvenile salmonids rely upon when stream temperatures in the Scott River are elevated.

Sediment/Substrate

Boulder Creek, **Canyon Creek**, and **Kelsey Creek** are all considered to be "Properly Functioning". Although survey specifics have varied over the years, these systems consistently

exhibit a low amount of fines when surveyed. Additionally, applicable CWE models are below critical threshold and road densities are low to moderate. The most recent set of comprehensive surveys for Canyon Creek and Kelsey Creek (between 2009 and 2015) detailed pool volume (V*) and surface/subsurface sediment composition, finding all four key indicators under consideration to meet reference conditions (USFS 2016a). Of note, Boulder Creek in 2014 began to visually exhibit an elevated amount of sand/silt (pers. obs.). Subsequent investigation traced the source to be somewhere above the Wilderness boundary, and the specific site is likely associated with movement of one of several known slide-prone areas. Due to the steep nature of Boulder Creek, the current elevated fine sediment load is expected to dissipate within a few years, dependent upon discharge from spring run-off and other events, and return to its normal baseline condition.

Scott River is characterized as "Not Properly Functioning". No recent substrate data is available for the Scott River mainstem. The Scott River drainage is 303(d) listed under the Clean Water Act as impaired for sedimentation/siltation. Furthermore, the Coho Recovery Plan appraisal of the Scott River watershed recognized altered sediment supply to be an important stressor to fish health, specifically identifying lower Scott River mainstem to be an area of heightened interest (NOAA 2014). Sources of excessive sediment loading were identified as both natural (i.e., granitic geology) and human-caused (i.e., roads, agriculture) in nature.

Turbidity

Turbidity within the Project area for **Boulder Creek, Canyon Creek**, and **Kelsey Creek** is "Properly Functioning". Modeling of soil loss and risk of mass wasting in the CWE analysis (**Table 4**) is under the threshold of concern and sediment composition, especially the finest elements (<2 mm), appears to be functioning properly (see "Sediment/Substrate" Indicator discussion). Personal observations following rain events and during spring run-off have not raised concerns about lingering turbidity, as water within the Project area clears quickly – within three days.

Scott River turbidity is likely "Functioning-at-Risk". Although substrate data is not available, the substrate of the river includes a high percentage of sand and silt, both from anthropogenic and natural (e.g., geologic) sources. This type of material is easily mobilized to the water column to create turbid conditions. Furthermore, turbidity has been observed to require multiple days, and even weeks after floods (e.g., 2005-2006 storms), to clear to its normal baseline following high water events.

Large Woody Debris

All waterways in the Project area – **Boulder Creek**, **Canyon Creek**, **Kelsey Creek**, and **Scott River** – are "Not Properly Functioning" for large woody debris. Both recent and past surveys in the Project area which included a large woody debris component found instream wood, as well as potential future recruitment, to not be at desirable levels (USFS 2015b, c; unpub. data). The lack of large woody debris, and the associated detrimental effect to fish habitat, including Coho Critical Habitat, has been repeatedly identified to be of concern (USFS 2000; NOAA 2014). The reason behind the lack of desirable amounts of large woody debris is multifaceted, and has been attributed to a combination of timber harvest, mining, altered fire regime, historic "cleaning" (removal) of wood from stream channels, and scour from large flood events.

Disturbance History and Regime

A "Properly Functioning" disturbance regime includes stable natural processes and hydrograph, where high quality habitat and watershed complexity provides refuge and rearing for all life stages or multiple life-history forms; and all three cumulative watershed models should be below the "1" threshold. This description fits all 5th-field and 7th-field watersheds within the Project area, except one: Deep Creek-Scott River 7th-field (**Table 4**). Alternately, an "At-Risk" disturbance regime, the frequency, duration, and magnitude of disturbance events have the potential to be moderately departed from the reference condition due to human-mediated impacts upon the watershed; and one or two of the models may be over threshold. Deep Creek-Scott River (7th-field watershed) falls under this designation. Finally, a "Not Properly Functioning" disturbance regime is described as a watershed with disturbance events significantly departed from reference condition as a consequence of past/current human activities; and all three models are over threshold. No Project watersheds fall within this lattermost disturbance regime. See **Appendix C** for additional information in regards to baseline Indicator determination.

The Deep Creek-Scott River 7th-field watershed is elevated over threshold in regards to the GEO component of the CWE model analysis. Of note is that this unit is a "compound" watershed consisting of drainages east and west of the Scott River which are not physically connected to each other. Furthermore, only a small proportion (< 10%) of the area, consisting entirely of fishless intermittent and ephemeral drainages, are within the Project footprint. The elevation of the GEO element appears to be linked with issues that do not occur in the Project area. These issues include past/current logging and roading, as well as fire, including the 2014 Happy Complex.

Table 4. Baseline and post-Project cumulative watershed models. Alternative 2 and Alternative 3 post-project outputs are the same.

Watershed	Acres	Baseline				Post-Project		
		ERA	%ERA	TOC	Risk	ERA	%ERA	Risk
7th-Field Watershed(s)								
Boulder Creek	2693	11	0.4%	8.0%	0.05	13	0.5%	0.06
Deep Creek-Scott River	3798	129	3.4%	9.0%	0.38	151	4.0%	0.44
Isinglass Creek - Scott River	5950	258	4.3%	8.0%	0.54	266	4.5%	0.56
Lower Canyon Creek	6535	116	1.8%	8.0%	0.22	225	3.4%	0.43
Upper Canyon Creek	5179	17	0.3%	8.0%	0.04	17	0.3%	0.04
NF Kelsey Creek	5177	108	2.1%	8.0%	0.26	108	2.1%	0.26
SF Kelsey Creek	6199	73	1.2%	7.5%	0.16	90	1.5%	0.19
5th-Field Watershed(s)								
Lower Scott River	97600	3562	3.6%	8.6%	0.42	3709	3.8%	0.44

Watershed	Acres	Baseline		Post-Project	
		USLE Risk	GEO Risk	USLE Risk	GEO Risk
7th-Field Watershed(s)					
Boulder Creek	2693	0.05	0.11	0.05	0.11
Deep Creek-Scott River	3798	0.35	**1.37**	0.37	**1.40**
Isinglass Creek - Scott River	5950	0.57	0.12	0.58	0.12
Lower Canyon Creek	6535	0.13	0.36	0.16	0.43
Upper Canyon Creek	5179	0.00	0.06	0.00	0.06
NF Kelsey Creek	5177	0.13	0.39	0.13	0.39
SF Kelsey Creek	6199	0.14	0.30	0.15	0.31
5th-Field Watershed(s)					
Lower Scott River	97600	0.28	0.50	0.28	0.51

Peak/Base Flow

Boulder Creek, **Canyon Creek**, and **Kelsey Creek** are "Properly Functioning". The ERA model is below critical threshold for all three drainages; road densities are low to moderate; roads are generally located outside of riparian areas (USFS 2000); effective stream shade is either not or minimally affected by human-caused impacts (USFS 2012); and while assessment of is difficult due to on-going recovery from past flood and fire events, riparian vegetation and cover is generally considered to be in good condition (USFS 2000).

Scott River is best described as "Not Properly Functioning". While the ERA model is below critical threshold, other considerations take precedence. In particular, low summer/fall base flows are identified as a primary issue of concern in regards to health of the aquatic ecosystem and its fauna (USFS 2000; NOAA 2014). The Scott River Valley, upstream of the Project area, has been altered from the pre-Euro-American settlement condition of marshy, wooded lowlands to irrigated fields and well-confined stream channels (NOAA 2014). During the present-day irrigation season, both surface and ground water are diverted for agricultural use, which has a downstream impact to the mainstem Scott River by decreasing base flow (USFS 2000; NOAA 2014). This impact is of greatest magnitude during periods of drought. Furthermore, riparian vegetation condition is considered to be poor in the Scott River Valley. In the Canyon area, including the Project area, mainstem riparian is judged to be "fair to good".

Drainage Network

Due to the complex history of the Project area, it is not possible to determine how human-caused impacts have increased the drainage network over pre-settlement conditions. In addition to road construction to access mining and timber sites, there are many ditches and other surface drainage alternations which conveyed water for mine and residential use. More recently, effort have been expended to improve watershed conditions, primarily through road and crossing improvement activities in Canyon Creek and Kelsey Creek drainages.

Boulder Creek and **Canyon Creek** are considered to be "Properly Functioning". CWE modeling of the ERA component is under the threshold of threshold; recent stormproofing has occurred in Canyon Creek to address a range of drainage issues; and, except at crossings, roads

tend to be set away from the mainstem creeks and their tributaries, minimizing direct/potential connectivity and creating hydrologic buffers between roadbeds and waterways.

Kelsey Creek is labeled as "Functioning-at-Risk". Although CWE models of the ERA component is under the threshold of threshold and recent stormproofing to address road drainage issues has occurred, there are additional factors when considering the overall drainage network. For example, the stormproofing effort neglected to include several miles of Road 44N45 past the Box Canyon Trailhead junction. Furthermore, Forest Road 44N44 beyond the Paradise Lake Trailhead, while closed to use and therefore also not stormproofed, has multiple drainage-related concerns associated with the old roadbed. Finally, the building of the Kelsey Spawning Channel near the mouth of Kelsey Creek in the 1980s increased the natural drainage network.

Scott River is classified as "Functioning-at-Risk". The Scott River is a complex system. The drainage has a whole has a long history of diversion and ditch construction for mining, agricultural, and residential uses. Many miles of ditches remain in active use, in addition to the unknown miles of unidentified legacy structures which no longer transport water, but which are present upon the landscape. Roads built upon both private and public land also impart their own impact in regards to the drainage network, depending upon location, active/potential connectivity to adjacent waterways, and how they were (or were not) designed. Due to active undertakings such as stormproofing, as well as the natural decades of decay/"self-decommissioning" of unused historic ditches and roads, the anthropogenic impact to the Scott River drainage network in and near the Project area has undoubtedly decreased over time. However, the drainage network remains elevated over the natural baseline, and it is the professional opinion of the Fish Biologist that "Functioning-at-Risk" best describes the current condition.

Riparian Reserves

Boulder Creek, **Canyon Creek**, and **Kelsey Creek** are characterized to be "Functioning-at-Risk". Although protocol specifics have varied over the years, when shade has been assessed, all three systems consistently exhibit a good to excellent degree of effective shade cover. Furthermore, stream shade measured in 2011 in association with temperature monitoring showed existing percentage of shade in all three watersheds to have no or minimal human-caused reduction (USFS 2012); and, thus, shade in these drainages is considered to be in a natural condition. The caveat with the Riparian Reserve Indicator is that other considerations than shade must be taken into account. A combination historic timber harvest (to the streambank in places), altered fire regime, flood events, and other natural/anthropogenic events have potentially affected the Riparian Reserves in a detrimental manner (USFS 2000; NOAA 2014). Additionally, there are localized impacts to Project area Riparian Reserves due to roads, recreational residences, and activity on private property. Of particular note, the 1964 flood flushed large woody debris from the system and scoured large segments of the streamside riparian zone of trees, resetting affected Riparian Reserves to an earlier seral stage. While fast-growing alders provide a very good degree of overhead shading and bank stabilization, woody debris which originate from this source are less preferred compared to mature conifers due to the latter's larger size and slower decay rate. Future recruitment of large conifers from the outer Riparian Reserves appear to be generally poor, likely due to factors such as past timber harvest and altered fire frequencies. Recovery of the Riparian Reserve in the Project area is continuing and is a long-term process.

The **Scott River** is "Functioning-at-Risk". The Coho Recovery Plan lists "degraded riparian forests" as a primary stressor in the Scott River drainage (NOAA 2014). While most of the focus on riparian health is upon the altered areas of the Scott Valley floor, shade in the Scott Canyon, including the Project area, is still only characterized as "fair to good". Mining and an altered fire regime – increased understory fuel loading – due to timber extraction and long-term fire-suppression practices are described as human-mediated impacts affecting riparian forests, particularly along mainstem Scott River.

Table 5. Baseline for analysis Indicators for anadromous streams in the Project area.

Stream/River	Temperature	Substrate	Turbidity	Large Woody Debris	Dist. History/Regime	Peak/Base Flows	Drainage Network	Riparian Reserves
Boulder Creek	P	P	P	NF	P	P	P	FAR
Canyon Creek	P	P	P	NF	P	P	P	FAR
Kelsey Creek	P	P	P	NF	P	P	FAR	FAR
Scott River	NF	NF	FAR	NF	FAR	NF	FAR	FAR

P - "Properly Functioning"
FAR - "Functioning-at-Risk"
NF - "Not Properly Functioning"

2017 Storm Event and Landslide Update

In early 2017, winter and spring storms, along with a high volume of spring run-off, created conditions that precipitated numerous slides within the Lovers Canyon Project drainages of Boulder Creek, Canyon Creek, and Kelsey Creek. Within the Project area, aquatic resources were affected by slides. However, slide-associated impacts – turbidity, increased fine sediment loading, increased large wood, scouring of riparian vegetation – largely originated outside the Project boundary; and were often initiated from Wilderness locations. For example, the largest known slide/debris flow within the Project drainages occurred at Maple Falls on Kelsey Creek. This event happened within the Marble Mountain Wilderness upon the footprint of the 2014 Happy Camp Complex fire, resulting in extensive channel scour and other impact for at least 0.5 mile of stream. Additional smaller slides were recorded within Kelsey Creek; and Boulder Creek ran turbid multiple times, likely as a result of earth movement of known slide-prone areas within Wilderness.

Multiple Indicators describing the existing condition were potentially altered as a result of the 2017 storm event. Of all the drainages, Kelsey Creek appears to have been the most affected, likely because of its location within the Happy Camp Complex footprint. The Indicators of interest include: temperature, sediment/substrate, turbidity, large woody debris, disturbance history/regime, and Riparian Reserve. Most changes are expected to be short-term, returning to the pre-storm baseline (as described previously in this section) in a few years. The exception is

large wood, which has the potential to undergo an AP framework upgrade in Kelsey Creek due to magnitude of debris loading that occurred following landslides and other events which delivered trees to the channel. However, a long-term change in functionality cannot be assessed for several years because of the need to demonstrate large wood retention in the system through several winter/spring seasons of high flows.

The environmental consequences of the Project for aquatic species and associated habitat are expected to remain similar to that already analyzed in the "Environmental Consequences" of this document. Project activities added to new baseline conditions will not create a situation whereupon a threshold of magnitude will be passed that alters analysis or species determinations because -

(1) Actions have been taken within the Project area to minimize additional impact to those slides which intersect commercial harvest units;
(2) Project activities are not expected to hinder or delay the natural trajectory of recovery of LCP creeks to their pre-2017 winter event baseline; and
(3) Effects expected as a result of Project activities do not significantly add to the new existing condition baseline established following the 2017 storm and run-off events.

For an expanded analysis relating to aquatic species and habitat, see the Addendum Memo to the Biological Assessment located in **Appendix E**. See the Environmental Assessment for full discussion of Project response to the 2017 storm event and landslides.

Environmental Consequences

Alternative 1 – No Action

Direct Effects and Indirect Effects

Under the No Action alternative, the Project will not happen and no management actions will be taken. See **Table 4** for baseline CWE models within the analysis area.

Legacy sites identified for the Lover's Canyon Project will not be treated. The effect to fish and fish habitat of not addressing these sites could range from not measurable to significant, depending upon the scenario and the species considered. The majority of locations are considered to be "low-risk" or "moderate-risk", whereupon current or potential sediment impact to their respective watershed is minimal. However, there are also multiple "high-risk" sites: the nearest location with elevated risk is about 250 feet from resident rainbow trout habitat, and more than one mile for anadromous habitat. The greatest potential for detrimental impact would occur if a large storm (100-year event or larger) affected the Project area. In the worst-case scenario of all legacy sites failing, up to an estimated 8,741 yd^3 sediment could be delivered to streams (USFS 2016b). For comparison, this amount of sediment would fill approximately 2.5 Olympic pools, else equate the volume of about 1.1 Goodyear blimps.

The impact to fish habitat from sediment produced due to failure of legacy sites is unknown. All major streams in the Project area, with the exception of Scott River, are considered to have good baseline water quality. If a single or several sites were to experience catastrophic failure the impact downstream is likely to be minimal and short-term. In the event of all sites failing concurrently, the amount of sediment as estimated above would be additional to that which would be naturally produced through other means, such as landslides. While there are multiple legacy sites throughout the Project area, most are distant from fish-occupied waters and/or require extensive overland movement of sediment to reach a waterway. Where sites are near fish-occupied waters, rainbow trout, particularly those found in SF Kelsey Creek, are at greatest risk for habitat alteration due to close proximity. Anadromous habitat is more distant from legacy sites; and while storm-related impacts are likely to occur, it would be difficult to separate sediment originating from natural and anthropogenic sources.

Cumulative Effects

There will be no cumulative adverse impacts to fisheries resources from the No Action Alternative. Past and on-going events within or adjacent to the Project area are considered to be part of the existing condition.

Future foreseeable actions planned at the time of this document include Lake Mountain-Middle Tompkins Allotment Management Plan, Westside Fire Recovery, Scott Mountain Underburn and Habitat Improvement, and Woolley Water/Road Special Use Permit Renewal (see "Alternative 2" subsection for summarized descriptions). Of these projects, only the boundary of Westside Fire Recovery overlaps that of Lover's Canyon Project, but neither include physical overlap of units, road use, or drafting sites. The other three projects share 7^{th}-field watersheds with the Lover's Canyon Project, but are otherwise spatially distinct in regards to implementation footprint.

Cumulative impact occurs when the effect of one project overlaps with or compounds the effects of another. The Lover's Canyon Project does not influence the implementation of any nearby

project, nor visa-versa. The primary consequence to fish and aquatic habitat of not doing the Project is related to legacy site impact. However, the legacy site risk is part of the existing baseline; and because the other projects are physically separate from Lover's Canyon Project, their activities will neither influence nor exacerbate the existing condition. Therefore, without direct effects or a compounding indirect effect, there cannot be cumulative effects for the No Action Alternative.

Alternative 2

Direct Effects

Direct effects to Coho salmon, Forest Service Sensitive species and management indicator species and their habitat can result from water drafting activities. For the Project, five drafting sites are within fish-occupied waters and therefore may affect fish and their habitat; and additional sites may be identified during implementation. One of these sites is within anadromous waters (Canyon Creek), and four sites are associated with resident rainbow trout (Boulder Creek [two]; SF Kelsey Creek [two]). Drafting operations can disturb staging or spawning adult fish, as well as impinge or entrain juveniles (Sicking 2003). Additionally, water drafting operations can mobilize suspended sediment to downstream aquatic habitat. Suspended sediment increases turbidity, exposing juvenile fish to gill damage and reduced oxygen uptake, and/or reduced vision and compromised feeding effectiveness. If water drafting were to occur with eggs present in adjacent redds, deposition of suspended sediment could fill interstices of stream bottom substrate, depriving incubating eggs of dissolved oxygen and resulting in their mortality.

While screening intakes can reduce effects to fingerlings and fry, minimization of impingement requires the use of specific mesh sizes, pumping rates, time and duration, and screen areas. Guidelines for drafting in anadromous waters are outlined in the *NOAA Fisheries Water Drafting Specifications* (NOAA 2001); and additional dirction for drafting in both fish-bearing and non-fish-bearing waters is provided by the Region 5 Soil and Water Conservation Handbook (USFS 2011). As described in Project BMPs and resource protection measures, drafting guidance from both NOAA and Handbook sources will be implemented during project water drafting, as appropriate for a given site. There is a very low probability of impingement because all locations have sufficient room for adult and juvenile fish to distance themselves from the screens. It is anticipated that fish temporarily avoiding water drafting activities by moving into adjacent habitat are not likely to experience reduced feeding success, nor result in a significantly higher probability of exposure to predators.

For water drafting, the frequency of effects is only during actual operations. Drafting will be done in accordance to the NOAA *Fisheries Water Drafting Specifications* (NOAA 2001) and Region 5 Soil and Water Conservation Handbook (USFS 2011), as described in the Lover's Canyon Environmental Assessment BMPs. By following these specifications, and considering the localized/small area of impact and short duration of water drafting, along with the mobility of fish to suitable adjacent habitat, the effects of water drafting in fish-bearing areas is likely to have only minor, insignificant direct effects on anadromous fish, including habitat, with no long term effects.

Other Project elements will not impart direct impacts to fish because no instream work is planned where these species are present within the Project boundaries. Drafting will occur at

established river access points: there will be no new construction, and, therefore, no alteration of the existing Riparian Reserve nor new delivery of sediment to the system.

Indirect Effects

--Salmonids--

Temperature

The project could impact stream temperature if vegetation treatments resulted in reductions in effective canopy shade over streams, and/or by reductions in stream flow due to water drafting.

Commercial harvest units were reviewed in regards to proposed equipment and treatment exclusion zones adjacent to stream channels. Vegetation treatments next to fish-occupied habitat are at least 170 feet from streams except in one unit, Unit 526-110 (see Table A-1 in **Appendix A**). The bottom/lower end of this excepted unit is bounded by Canyon Creek road (Forest Road 44N45), which forms a downslope boundary beyond which Project effects to effective stream shade along Canyon Creek are avoided. The closest approach of Unit 526-110 to Canyon Creek is about 100 feet. Due to the width of the road, its location, and general topographic configuration, trees in Unit 526-110 next to the road are largely disconnected from their riparian function, including shade. Elsewhere in the Project area, the treatment buffer may be as little as 15 feet in plantation units and 50 feet in natural stands. These latter locations are all associated with small fishless channels, where setbacks are wide enough to maintain sufficient canopy shade to not affect water temperature. Commercial treatment units have been reviewed by resource specialists and confirmed that habitat elements, including effective stream shade, will be maintained. Therefore, because shade will be preserved, there is not likely to be any meaningful effect to fish-bearing reaches, including Coho salmon Critical Habitat, due to this project (USFS 2016b; Fish Biologist field review).

Although there is much research on the impact of wildfire on streams and their associated riparian habitat, there are relatively few studies on the effects of prescribed burning comparing a multitude of variables before and after (short- and long-term) the action. Two relatively recent studies are:

- Arkle and Pilliod (2010) followed effects to components of riparian and stream habitat on an Idaho forest which utilized a spring burn prescription similar to what the KNF could employ for the Project. Variables were tracked for three years.
- Beche, *et al*. (2005) observed riparian impact within a California research forest using an aggressive prescription, including a fall burn with deliberate riparian ignition. Variables were tracked for one year.

Both studies included control versus pre- versus post-fire habitat measurements. Neither reported a meaningful effect to overstory riparian vegetation, although the more aggressive prescribed burn did observe a significant impact to understory vegetation. With no change to stream cover (and, hence, effective shade), no negative alteration to temperature is expected. Arkle and Pilliod (2010) did include water temperature among observed variables and found no change as a result of prescribed burn activities.

Water drafting results in minor short-term reductions in stream flow during withdrawal operations. Implementation of drafting consistent with NOAA specifications (2001) ensures that

project drafting will not remove greater than 10% of stream flow at a site within anadromous habitat. Drafting from Canyon Creek will not have any meaningful impact to water temperature within range of anadromy due to the stream's relatively large size and flow volume, which in turn renders any short-term changes in flow (which would be less than 10% reduction) that might affect stream temperature as insignificantly small.

Water drafting in non-anadromous habitat will also follow NOAA drafting specifications (2001), which require operations to not reduce flows by more than 10% downstream of the drafting site. These sites are perennial and may be fish-bearing or non-fish-bearing, as per shown in the maps. While the NOAA drafting specifications are designed to safeguard anadromous fish, the restrictions will also benefit resident rainbow trout habitat at sites where they are present; and drafting BMPs/RPMs applicable to trout will be used. Local reductions in flow volume will not significantly affect stream temperature for the same reasons provided for drafting in anadromous reaches: change in overall flow volume is short-term and minimal compared to normal discharge.

Drafting will not affect thermal refugia. As per above discussion, small, short-term change in stream flow will not affect local stream temperature; and, therefore, there can be no alteration to thermal refugia. Furthermore, distances from thermal refugia to nearest drafting site are large in most cases – Boulder Creek: 0.8 miles; Canyon Creek (sustains relative large summer base flow): 200 feet; Kelsey Creek: 4.1 miles.

Summary

The project will have a minor, short-term effect to stream flow during water drafting operations. However, the effects are neither likely to have any detectable change to stream temperature in fish-bearing reaches or have any meaningful impact to fish habitat, including thermal refugia. There will be no meaningful effect to stream temperature from commercial harvest activities because effective stream shade will be maintained via activity restriction in Riparian Reserves. Similarly, prescribed fire will not impact stream temperature because overstory riparian vegetation will be maintained.

Substrate/Sediment

The Lover's Canyon Project presents multiple pathways for sediment to potentially affect fish habitat – harvest and silviculture treatments, prescribed burn, and legacy sites. This subsection will discuss each major component separately, then summarize the results.

Harvest and Silviculture Treatments

For all commercial treatment units, either a variable width equipment exclusion zone, or the edge of the inner gorge, whichever is furthest, have been defined to provide a sediment buffer for creeks. Sediment buffer widths were in part formulated based (1) upon presence of fish, or (2) location of a fishless stream (perennial or intermittent) on the landscape in relation to road crossings and fish-bearing waters (**Figure 1**).

- Fish-occupied stream – minimum equipment exclusion zone of 170 feet (i.e., one potential site-tree width).
- Non-fish-occupied stream – minimum equipment exclusion zone of 100 feet applies to units or portions of units located down-gradient of road crossings, and no other crossing is present between the unit and a fish-occupied waterway.
- Non-fish-occupied stream – minimum equipment exclusion zone of 50 feet applies to units or portions of units located up-gradient of road crossings.

Equipment which disturbs the ground is the focus of the equipment exclusion zone. Certain classes of machinery – i.e., tractors and skidders, particularly if sporting tracks instead of rubber tires – have a greater impact than other types. Therefore, the equipment exclusion zone primarily relates to ground-based harvest (e.g., "tractor" units). In contrast, skyline units are too steep for tractor harvest, and must yard trees to a road or landing where the skyline equipment is stationed. Equipment which processes, stacks, and/or loads logs to trucks is similarly restricted to landings and roads. Likewise, equipment operation associated with units designated for endlining are similarly limited in their movement.

The distance of 100 feet (or more) aligns with general recommended buffer widths for effectively filtering sediment for activities such as logging.

For commercial units with an equipment exclusion zone of 50 feet, reviews have occurred by resource specialists (e.g., geologist, hydrologist, and/or soils scientist) to confirm suitability of the distance to buffer sediment in an acceptable manner. Furthermore, multiple design features (see Chapter 2 of EA) proven effective in preventing the rilling and gully formation that can convey fine sediment into active channels have been applied to the Project (USFS 2016c,d), including Wet Weather Operation Standards.

There are several exceptions to the equipment exclusion distance:

- Unit 526-110 – Canyon Creek road (Road 44N45) is the primary access route into the Project area for all public and Forest personnel. Therefore, this road has been set as the lower boundary of the unit. While the boundary edge is thus less than 170 feet from Canyon Creek, it is still more than 100 feet. Risk of overland sediment movement in measurable amounts to affect fish habitat is very low because (1) it is a skyline unit, and thus expected to have a relatively low ground disturbing impact; and (2) Canyon Creek road hydraulically disconnects the hillslope from the creek, serving as an constraint to intercept sediment movement.
- Units 526-097, -098a, -110 – The intermittent channel mapped as originating from an upslope meadow is not present, as per field review. Without a stream, no associated equipment exclusion zone is necessary.

Although mechanized equipment movement is the primary manner by which sediment may be mobilized and conveyed to waterways, skidding or endlining of logging material can also disturb the ground and initiate sediment impacts. Therefore, commercial treatment units also include no-treatment buffers to minimize near-stream ground disturbance.

- Fish-occupied streams – no-treatment buffer is the same as the equipment exclusion zone – 170 feet on either side of a stream channel.
- Non-fish-occupied stream (natural stand unit) – no-treatment buffer is the same as the equipment exclusion zone – 100 feet or 50 feet on either side of a stream channel, depending on the absence/presence of road crossing downslope, as described above.
- Non-fish-occupied stream (plantation unit) – minimum no-treatment buffer is 15 feet.

To meet the purpose and need of the Project, it was deemed necessary to treat overstocked commercial plantation units to the maximum extent possible, including within Riparian Reserves and adjacent to stream channels. The number of units (7) which may have commercial activity within the equipment exclusion zone is minimal. Although no equipment is allowed within a 50 foot or 100 foot buffer, as described previously, manually cut trees can still be endlined or otherwise removed from this area. Project design features, such as not skidding across stream

channels, are in place to maintain the integrity of ground nearest the channel and thereby minimize the potential for overland sediment movement to streams. Additionally, units are sited adjacent to small, intermittent, fishless drainages.

There are several exceptions to the no-treatment buffer distance:

- Unit 524-055 – Upon field review, the outer edge of the unit boundary was found to be 140 to 150 feet to Boulder Creek, and several trees (less than 10) between 150 and 170 feet were marked for harvest. These trees were mistakenly marked: the marking crew had been instructed that the unit boundary was to be 150 feet from Boulder Creek (T. Coughlin, pers. comm.). Because difference in buffer width (150 feet versus 170 feet) will not appreciably change the potential for sediment input to Boulder Creek at this location, removal of these trees within the no-treatment area will be allowed. Of note, although the unit boundary is less than 170 feet to a fish-bearing stream, the equipment exclusion zone will not be encroached. This is because the unit is categorized as "skyline", with all vehicles/skyline equipment restricted to the road and outside the equipment exclusion zone.
- Unit 526-110 – Harvest will occur closer than 170 feet to Canyon Creek. See discussion above regarding equipment exclusion zone.
- Units 526-097, -098a, -110 – The intermittent channel mapped as originating from an upslope meadow is not present, as per field review. Without a stream, an associated no-treatment buffer is not necessary.

Equipment exclusion distances and treatment buffers for commercial units which include a Riparian Reserve element are summarized in **Appendix A**.

For pre-commercial thin activities, units which include mastication will utilize the same equipment exclusion zone as described for commercial harvest units. Except in the case of masticators, an equipment exclusion zone is not needed for manual treatments because implementation will be accomplished with chainsaws and similar low-impact equipment (i.e., no vehicles). Furthermore, because activities within pre-commercial units will minimally disturb the ground – cutting/piling small diameter trees and brush, limbing, lop/scatter, no skidding – there is no need for a treatment buffer. Specific project design features, such as not cutting trees rooted in streambanks, prevent direct impact to creek channels. The masticator may reach into the equipment exclusion zone with its arm to grind trees, but material beyond the machine's reach will be attended to using manual means. A Biological Assessment completed by the Klamath National Forest determined that the amount of sediment generated from typical pre-commercial thin actions was insignificant and was unlikely to have a discernable impact to fish habitat (USFS 2001). Prescribed fire, including underburning and pile burning, is described later in this document.

The Hydrology Resource Report reported an expectation that sediment produced from timber harvest and thinning activities could have a localized, short-term effect to water resources (USFS 2016b). The effect would be limited to the site scale (i.e., at or near the treatment area and less than 100 meters [~330 feet] downstream) and be present for less than one year. Due to the location of silviculture activities, neither fish nor their habitat are found at the hydrologic site scale; and because no measurable sediment effects are expected to be occur at the larger landscape scale, such as the 7th-field watershed, fish-occupied habitat is not anticipated to be affected.

Field review by specialists indicate hydrologic function within the Project area, including flows of intermittent streams, will be maintained. No accelerated surface runoff is expected and landslide risk will not be significantly elevated above existing background values (USFS 2016b,d). See "Disturbance History and Regime" subsection for further discussion, including CWE model results (**Table 4**).

Summarized for the proposed action, Project harvest and silviculture treatments mostly occur adjacent to fishless streams; and where fish-bearing stream reaches are present within the Project boundary, they are appropriately buffered from ground disturbing activities. Existing hydrologic function will be maintained throughout the Project area. Therefore, sediment will not be conveyed to fish-occupied waters in a significant, discernible quantity over existing background variability.

Prescribed Burning

Prescribed burning – underburning and pile burning – is expected to impart minimal sediment-associated effects to fish and fish habitat within the Project area. A Biological Assessment completed by the Klamath National Forest determined that the amount of sediment generated from typical prescribed burning activities was insignificant and was unlikely to have a discernable impact to fish habitat measures (USFS 2001).

Several investigations on the effects of prescribed fire provide support to the view that instream sediment impact due to underburn treatments is negligible. A multi-year study of effects to riparian and stream habitat following a typical Forest Service prescribed fire was conducted on the Payette National Forest in Idaho (Arkle and Pilliod 2010). The prescription – upslope low-intensity; no ignition in riparian, although fire allowed to back in – was similar to what is anticipated to occur in the Project area. The conclusion was that disturbance to the riparian corridor would have to be much greater, for instance a higher fire intensity and/or more riparian area burned, before impacts would be observable beyond that expected by natural background variation. A second study did look at the post-fire response to a more aggressive fire prescription (Beche, *et al*. 2005). Located in north-central California, treatments included active riparian ignition during an early-fall burn window to produce patches of low- to moderate-intensity severity within the riparian corridor. Although understory vegetation experienced significant reduction, there was no change in fine sediment input, and the riparian continued to act as a functional buffer to the moderate-intensity burn on adjacent upland slopes.

Summarized for the proposed action, Project prescribed fire treatments, including underburning and pile burning, are expected to have no measurable effect to fine sediment input or substrate composition in streams. Project design features will ensure that Riparian Reserve fire severity will remain low and patchy in extent. Any sediment input resulting from prescribed fire actions will be minimal and not discernable over existing background variability.

Legacy Sites

Treatment for most legacy sites will require mechanized equipment that causes ground disturbance. Except in the case of those locations which include an instream component, any sediment impact is expected to remain localized to the roadbed and near-slope areas. Only legacy sites with an instream component have the potential to affect waterways. As part of project planning and implementation, resource specialists design, and monitor the use of, project-specific BMPs to ensure crossing upgrades are employed so that short term impacts to fish

habitat, especially related to sediment, are sufficiently minimized. Project legacy site activities which occur in association with stream channels (ephemeral, intermittent, or perennial) are generally well above habitat occupied by fish, and potential sediment generated from these activities is likely to be undetectable greater than 300 feet downstream of the site and therefore would not have any measurable effect to fish or their habitat.

Long-term, legacy site repair will benefit watersheds in the Project area. Because legacy sites will be repaired individually over an extended time interval and not as a comprehensive stormproofing package, CWE models are unable to show instantaneous improvement. However, by attending to the legacy sites within the Project area, risk from human-caused sediment impacts will be reduced by an estimated 8,741 yd^3 once all locations have been mitigated (USFS 2016b). This action will contribute to the continued maintenance of Project watersheds as Properly Functioning in regards to sediment.

Summary

Most sediment which is mobilized by Project activities is expected to remain small and localized near to the site of disturbance/origin. Additionally, because there will be no measurable transport of sediment to fish-occupied areas above the background level, Indicators which directly or indirectly rely upon this metric (turbidity, pool frequency and quality, width/depth ratio, and floodplain connectivity) will not be affected. Due to the location of the Project upon the landscape, functionality of Riparian Reserve buffers, project design features, and BMPs considered adequate to control overland movement of sediment, neither fish nor their habitat will be significantly affected by changes to the sediment regime caused by Project activities.

Turbidity

Only work associated with legacy site repair and water drafting would occur within a stream channel, potentially creating turbidity. The amount of ground disturbance and associated stream turbidity likely as a result of the crossing upgrades is limited in scope and intensity. The Forest Service has consulted with NMFS both programmatically and on a project-specific basis on this type of work since Coho salmon was ESA-listed in 1997. As part of project planning and implementation, resource specialists design, and monitor the use of, project-specific BMPs to ensure crossing upgrades are employed so that short term impacts to fish habitat, especially related to sediment, are sufficiently minimized. Additionally, for this project, most legacy site activities which occur in association with stream channels (ephemeral, intermittent, or perennial) are well above habitat occupied by fish, and, therefore, potential sediment generated from these activities is likely to be undetectable greater than 300 feet downstream of the site (**Table 6**). Due to distance (>500 feet), there would be no effects to anadromous fish or their habitat. Although the distance of two legacy sites to occupied rainbow trout habitat is short (<300 feet), in both cases the connection to the creek is ephemeral and, thus, no turbidity effect will occur because the work areas will be dry during implementation.

When drafting from Canyon Creek, a small plume of suspended sediment is expected during operations, particularly when hose is set into and pulled from the water. As discussed in the Direct Effects section, turbidity will be localized, minimal in extent and duration, with the most likely fish behavior to be one of avoidance. No measurable increase in turbidity or bed load is expected beyond the immediate area where drafting occurs. Turbidity associated with similar water drafting has been observed to be momentary, localized, and quickly dissipating to background conditions. It is unlikely that the small, ephemeral plumes of sediment produced in

the immediate area where drafting occurs might expose fish, including Coho salmon, to gill damage, reduced oxygen uptake, reduced vision, or compromised feeding because the expected behavioral response of fish is avoidance and their ability to sufficiently avoid the disturbance likely.

Table 6. Closest legacy site distance to fish-occupied waters by drainage.

Drainage	Legacy Site	Approximate Distance To -		
		Anadromous Species	Critical Habitat	Resident Rainbow Trout
Boulder Creek	44N53Y-1.49	1.2 miles		0.15 miles
Canyon Creek	44N35-0.40	0.15 miles		
Kelsey Creek	44N45-9.34	2.7 miles		-
	44N45-11.56	-		~250 feet

Large Woody Debris

The Project is designed to be consistent with large woody debris standards described in the Forest Plan. Already down coarse wood will not be removed from Riparian Reserve areas or stream courses; and resource protection measures and BMPs associated with prescribed burning minimize impact to large woody debris.

The Project area is "Not Properly Functioning" in regards to large woody debris. Due to this existing condition, activities within the Riparian Reserve, with a special focus on commercial harvest units, were planned to best maintain current and future woody debris input, while still allowing for the purpose of the overall Project. Different "no-treatment" buffers were devised for harvest units, based upon presence/absence of fish in unit waterways, location of culverts, and silviculture/fuels need (**Figure 1**).

No Treatment Buffer [170 feet] (All Harvest Units – Fish-Bearing Streams)

Treatment buffer applies to fish-bearing streams traversing or adjacent to all harvest units (plantation or natural stands). Total units in this classification is six (6). The 170 foot distance is one "site potential" tree, and well beyond the 100 foot (~30 meters) distance that Benda and Bigelow (2011) concluded as where ninety percent of large wood recruits originate. The 170 foot no-treatment buffer distance is also beyond that modeled by Benda, *et al*. (2015) whereupon 2/3 tree height is suggested to be sufficient to maintain wood recruitment at 95 percent (e.g., 2/3rds of 170 foot tree height equates 112 feet).

Trees thinned from commercial harvest units adjacent to fish-bearing streams are expected to be less than 170 feet long. For those stands sampled, average tree height was around 100 feet (unpub. data). Within all Project harvest units, trees greater than 170 feet are very rare and associated diameter-at-breast height (dbh) to be at least 55 inches (unpub. data). Focus of harvest to achieve future desired conditions in regards to tree size composition is upon material 25 inches dbh and smaller, a size class too small for a thinned Project tree to have achieved a 170 foot height. Furthermore, these trees will originate from the outer portion of the Riparian Reserve, beyond the 170 foot mark. These details further diminish the likelihood that Project thinning will affect existing recruitment because the no-treatment buffer is wider than height of

trees expected to be available for harvest; and trees harvested will originate outside the zone from where most recruitment occurs.

The exception to the 170 foot no-treatment buffer is Unit 526-100. The bottom of this unit is bounded by Canyon Creek road (Forest Road 44N45), the primary access route to several popular Wilderness trailheads, as well to other recreational opportunities. The closest approach of the unit to the creek is about 100 feet. To preserve access, any trees which fall across the road are quickly cut up and removed, and, therefore, do not contribute large woody debris to Canyon Creek.

Overall, it is expected that large woody debris recruitment to fish-bearing streams within harvest units will remain similar to the rates currently existing.

No Treatment Buffer [100 feet] (Harvest Units – Natural Stands)

This treatment buffer applies to streams traversing or adjacent to natural stand harvest units which are located down-gradient of road crossings, and no other crossing is present between the unit and a fish-occupied waterway. All systems are fishless; and channels may be intermittent or perennial in character. A total of four (4) units are identified as falling partially or entirely within this category. Due to the stand location, there is no barrier to movement of woody debris and their potential subsequent recruitment to fish-bearing waterways. Therefore, a 100 foot (~30 meters) no-treatment buffer encompasses the Benda and Bigelow (2011) ninety percent wood recruitment zone.

On the local scale, the no-treatment buffer is expected to be equal to or greater than the height of most trees targeted for harvest. While commercial units within this class were largely unsampled in regards to tree height or diameter, across the entire Project area, average existing tree height for all sampled commercial units was less than 100 feet; and average harvest height is also less than 100 feet (unpub. data). The implication is that the trees marked for harvest would have a low likelihood of recruiting to large woody debris, even if they were left in place, because they are generally shorter than the no-treatment buffer.

Overall, it is expected that large woody debris recruitment to headwater streams within natural stand harvest units and subsequent transportation will remain similar to the rates currently existing. Very long-term, thinning within the 170 foot Riparian Reserve boundary may accelerate the growth of unharvested trees into larger conifers (>100 foot height), which in turn would be close enough to streams to increase contribution to in-channel large wood loading.

No Treatment Buffer [50 feet] (Harvest Units – Natural Stands)

This treatment buffer applies to streams traversing or adjacent to natural stand harvest units which are located up-gradient of road crossings. All systems are fishless; and channels may be intermittent or perennial in character. A total of sixteen (16) units are identified as falling partially or entirely within this category. Due to the stand location, there are one or more road crossings between the unit and fish-bearing waters. The existing condition of woody debris transportation is thus already compromised: any large wood which gets caught at the crossings is cut up and removed before it can threaten road integrity. Therefore, large wood which originates from harvest units upstream of road crossings is not expected to recruit to fish-bearing streams.

The importance of small wood in headwater streams is not well studied. Due to the smaller width and power of headwater channels, such as those in the majority of the Project area, debris smaller than traditional fish-bearing stream "large wood" may nonetheless have a significant function.

Jackson and Strum (2002) looked at the role of wood in non-fish-bearing headwater channels and observed small wood less than 15 inches (40 cm) to be important in sediment storage, the creation of steps that reduce stream energy, and contribution to amphibian and invertebrate habitat. Small wood debris appeared to largely originate from mortality, wind throw, and limbs falling from trees.

The 50 foot (~15 meters) no-treatment buffer is within the Benda and Bigelow (2011) ninety percent wood recruitment zone, as well as the Benda, *et al*. (2015) recruitment area of 95 percent, adjusted to two-thirds of the Project site potential tree (e.g., 2/3rds of 170 foot tree height equates 112 feet). More specifically, the width of the no-treatment buffer is less than the average height of sampled trees targeted for harvest within this classification (unpub. data). Thinning of trees beyond the 50 foot buffer thus has the potential to affect small woody debris recruitment to headwater streams and, therefore, impact local stream function imparted by those debris. However, any negative effect is expected to be minimal. If a tree did recruit from outside the buffer, the portion affecting the channel would likely be the topmost tapering crown section. While all debris have the potential to affect a stream, structurally functional pieces tend to be longer trunk segments or robust limbs in the 4 inch to 15 inch (10 cm to 40 cm) range (Jackson and Strum 2002). These pieces are expected largely to originate closer to the stream channel, and as such, thinning outside the no-treatment buffer is expected to have a minimal, localized impact.

Overall, there may be a short-term decline in wood debris, but the effect on fish-bearing reaches will be minimal. There will be no changes in existing recruitment of larger pieces, such as those recognized to benefit habitat in fish-bearing streams, because the presence of culverts below harvest units restricts the downgradient movement of these debris. The recruitment rate of small wood debris to headwater channels may be decreased, leading to a localized effect, but a noticeable impact downstream within fish-bearing reaches is not expected.

No Treatment Buffer [<50 feet] (Harvest Units – Plantation Stands)

Treatment buffer applies to streams traversing or adjacent to plantation stand harvest units. All systems are fishless; and channels may be intermittent or perennial in character. A total of six (6) units are identified as falling partially or entirely within this category. All harvest plantation units which include a Riparian Reserve component are associated with headwater streams. Plantation units are currently overstocked with smaller size-class trees, and there is need to aggressively thin to allow for faster growth of remaining trees, decrease disease and insect mortality, and decrease fuel loading (USFS 2016e). Because plantations were planned without regard to stream presence, it is not possible to exclude near-channel thinning from the silviculture prescription without compromising one or more of the Project purposes. Where appropriate, trees may be thinned as close as 15 feet from a stream channel (equipment exclusion zones still apply, but cut material could be removed by endline or by hand).

For all harvest unit plantation stands within this category, one or more culverts limit transport of large woody debris to fish-bearing waters. Therefore, focus is on potential effect to stream systems at the site level in regards to smaller debris. Similar to the natural stand no-treatment discussion, thinning may decrease the amount of debris entering the system, which in turn could affect local stream processes. For plantation units, the average height of the majority of trees marked for harvest is 60 to 63 feet (and 8 to 14 inch dbh). Because thinning will be more aggressive in plantation units compared to natural stands, both in amount of timber removed and reduced cutting approach distance from stream channels, it more likely that localized stream

effects could occur due to decreased input of small wood. However, this potential site-level impact is not expected to affect downstream fish-bearing reaches because transport of this undersized material in measurable quantities to downstream habitat will be arrested at road-stream crossings.

Pre-Commercial Thin and Fuelbreaks

To meet objectives, pre-commercial thin units and fuelbreaks will target small trees and brush less than 10 inches dbh. While masticators may be used in some pre-commercial units, an equipment exclusion zone prevents close approach to waterways. Therefore, all near-stream activities will be accomplished via manual methods. Except for BMPs and resource protection measures that prohibit the cutting of trees directly rooted in stream banks, there are no treatment exclusion distances. Units associated with fish-bearing waterways are limited to a few sites; and within Coho CH or EFH, all units are manual prescriptions which are sited at the extreme edge of the Riparian Reserve, and thereby activities will be far (>300 feet) from the stream. Additionally, the size of material being removed is too small to affect pool formation or other habitat attributes at these locations. Elsewhere, the potential effect to headwater systems will be localized and have minimal to no effect to downstream fish-bearing reaches, as previously described.

Summary

Effect to recruitment and transport of large woody debris of an appropriate size to affect habitat attributes of fish-bearing streams is not expected. Creeks with fish and fish habitat adjacent to harvest units will retain similar rates of current large woody debris recruitment. Where a decreased input of smaller debris may affect function of fishless headwater systems, the impact will be short-term, localized, and unlikely to be noticeable downgradient within fish-occupied reaches. In the long-term, benefits are expected throughout the Project area via the growth of larger trees which may contribute to future large woody debris input.

Disturbance History and Regime

Ground disturbance within the Project area will include the following activities: landing construction, timber harvest, pre-commercial thin, fuels treatment, and prescribed burn elements consisting of pile-burning and underburning. Prescribed burning will occur within commercial and pre-commercial units, as well as upon the general landscape. Additional ground disturbance will occur in conjunction with legacy activities, such as repairing culvert crossings, and where temporary roads are re-established on existing roadbeds, then hydrologically stabilized post-Project.

One or more disturbance indices will increase in most watersheds as a result of Project implementation (**Table 4**; USFS 2016b,c). The greatest increase, inclusive all three models, will be associated with Lower Canyon Creek 7th-field watershed. Other drainages will sustain small or no increases in the various models. No drainages will cross the "1" threshold of concern as a result of Project actions. The Deep Creek-Scott River 7th-field watershed will maintain an elevated GEO risk rating, but the Project will not change the functional level of any indicator characterized by GEO, notwithstanding the small expected increase in risk ratio (1.37 to 1.40).

The bulk of ground disturbing activities will occur in Lower Canyon Creek 7th-field watershed, which, in turn, leads to the largest increase in the models. This watershed also has the greatest percentage of area disturbed by the Project. Potential ground disturbing activities include

commercial, pre-commercial, and fuelbreak treatments; prescribed burn; and temporary road use. Most of the model increases occur from commercial harvest and prescribed burn. Prescribed burn is notable because while individual acres do not appreciably contribute to the model, its diffuse nature over much of the watershed (1,489 acres) adds up.

The cumulative landscape-level effect within the Lower Canyon Creek watershed does not pass threshold for any model, and the burden may be less than it initially appears. First, the models are based upon acreages without spatial awareness of unit location or measures taken to decrease impact of Project elements. For example, equipment buffer zones are present within units that include stream and/or Riparian Reserve features, but these setbacks are not specifically reflected upon GIS-produced layers (which are used to determine acreages) due to logistical complexity of display. Second, models assume uniform disturbance, which is not true for prescribed fire. Specifically, fire in the riparian areas is expected to exhibit a spatial patchiness and display a lower severity compared to upland areas, thus maintaining sediment buffering capacity. Finally, models assume that all Project actions will be completed in a short amount of time, which does not mesh with the reality that implementation of various components is likely to require years. For instance, while commercial harvest may occur within a 1-2 year time span, prescribed fire may not begin until several years into the Project, after harvest and pre-burn preparatory actions are complete. Even then, prescribed fire is expected to be accomplished over multiple years as funding, weather conditions, and personnel allow.

In summary, while there are CWE model increases as a result of this Project, there will be no significant effects to aquatic habitat from any Project activities. Model estimates for ERA and USLE remain below the critical threshold; and estimates for GEO, while over threshold, are not appreciably increased as a result of the Project (USFS 2016b,c). Additionally, because all models remain below threshold or will not functionally change, Indicators which directly or indirectly utilize this metric (i.e., peak/base flows, floodplain connectivity, substrate, turbidity, and width/depth ratio) will not be measurably affected.

Peak/Base Flow

At the site level, water drafting will occur in Canyon Creek (anadromous), and Boulder Creek and Kelsey Creek (resident rainbow trout). Therefore, there is the potential for short term, indirect effects downstream. Water drafting at upslope sites where no fish are present will also result in localized changes in flows, but these will not be measurable/discernable at occupied habitat downstream. This is because, at all Project drafting sites, pumping rate will not exceed 350 gallons per minute or 10% of the flow of any anadromous stream and pumping is done in short periods. Water drafting will result in only slight temporary decreases in flow, which will be undetectable both a short distance downstream and further downstream in fish-occupied habitat. In large systems, flows are not measurably affected by typical short-term drafting operations such as those required to fill a water tender (Sicking 2003). Additionally, as analyzed in the Facility Maintenance and the Facilities Maintenance and Watershed Restoration BA, the effects of water drafting are considered insignificantly small (USFS 2004).

There will be no watershed-scale changes to peak/base flows as a result of Project activities due to treatment unit location on the landscape, minimal and localized impacts, and functioning buffering capacity of intervening Riparian Reserve habitat. This is reflected in ERA model output, which remains below the threshold of concern (see "Disturbance History and Regime" subsection).

Drainage Network

The construction and/or reoccupation of existing landings and skid trails will create a temporary increase in the local drainage network while Project commercial thinning is ongoing. Any effects will be short-term and confined to treatment units in upslope areas. Resource protection measures will help ensure that drainage impacts are short-term and localized. This is because skid trails will not cross perennial streams, and intermittent streams will only be crossed while dry and at pre-approved locations. In the long-term, there will be no increase in the drainage network from these timber harvest-related activities because landings and skid trails will be rehabilitated.

Roads can have a major impact on the drainage network. The Project will affect no change in miles of road upon the landscape and there will be no motorized use of currently closed or decommissioned roads recognized under the National Forest Travel System. Most temporary roads (~1 mile) will be placed upon existing within-unit roadbeds or haul/skid routes which have been used in the past. Two new routes will be constructed to access landings, but total length will be very small – ~370 feet (0.08 mile). After their use during the Project, causing a slight temporary increase in the drainage network, all temporary roads will be hydrologically stabilized. This includes pulling any stream channel crossings, outsloping road prisms if appropriate, and obliterating access to the road. Overall, these actions are expected to insignificantly decrease human-caused increases in the drainage network because these temporary roads segments will be left in a similar or better hydrologic state than their pre-Project condition. Because the pre- and post-Project condition will be similar on the landscape scale, any long-term beneficial effects are too small to be accounted for in the CWE ERA model analysis. Additional localized benefits are expected at legacy sites, the treatment of which will correct adverse instream hydrologic issues.

Summarizing, in the short-term, there will be an insignificant increase in the drainage network from temporary roads, landing, and skid trail construction, with these impacts neutral in the long-term due to subsequent rehabilitation and natural stabilization. Long-term, there will be an insignificant decrease in the drainage network following hydrologic stabilization of temporary roads and legacy sites repair.

Riparian Reserves

Project activities within Riparian Reserve include commercial and non-commercial silviculture treatments, fuels abatement, prescribed burn (underburn), and water drafting. New landings will not be constructed within Riparian Reserve, although existing ones may be reoccupied temporarily. Where existing Riparian Reserve landings are used, they will be hydrologically stabilized after the Project. Resource protection measures will ensure Riparian Reserve character will not be detrimentally altered by Project activities. In some treatment units, a long-term benefit may occur via the promotion of growth of larger trees.

Of note, mapped overlap of harvest units with the Riparian Reserve management area is likely overestimated (**Map 5**; Project record). Riparian Reserve widths are measured using slope distance. However, to produce a Riparian Reserve buffer, the GIS system assumes the landscape to be flat; and, therefore, may not accurately reflect local slope conditions. The degree of error between GIS-mapped terrain and on-the-ground reality becomes most evident in landscapes which include stream downcutting and deep gorges, whereupon GIS estimates of Riparian Reserve extent and its boundary as a function of horizontal distance from a channel may be

greatly overestimated. Within the Project boundary, field review indicates that this "GIS vs. real terrain" discrepancy is present is many areas, and as such actual Riparian Reserve acreage affected by Project actions is less than the GIS-based calculations. Several specific discrepancies have been discussed previously within "Substrate" and "Large Woody Debris" subsections. One prominent example is an intermittent stream which is mapped to affect units 526-091, 526-098a, and 526-110. This intermittent stream does not exist and, thus, an approximate 13 acres of GIS-mapped Riparian Reserve are also not present. Unit boundaries were positioned on the ground and varying treatments and buffers applied to avoid or minimize impacts to Riparian Reserve.

Harvest and Silviculture Treatments

Riparian Reserves within the Project are "Functioning-at-Risk". The departure from natural conditions is largely due to long-term policy of complete fire suppression, as well as historic harvest practices which selected the largest trees and/or clear-cut to the streambank, actions of which were often followed by overplanting (NOAA 2014; USFS 2000). The result are Riparian Reserves – riparian forest and connecting uplands – which tend to be overstocked with smaller size classes of trees, while at the same time deficient in the largest trees (live and standing dead) that have the greatest potential to affect stream resources should recruitment occur. In turn, when a catastrophic natural event, such as scouring flood, occurs, the stream system is likely less resilient and takes longer to recover than under desired riparian conditions.

BMPs and resource protection measures minimize Project-associated impacts of disturbance, roading, and changes to temperature (i.e., shade) within the Riparian Reserve. Therefore, the focus of discussion for Riparian Reserve character as potentially affected by Project harvest and silviculture treatments is centered upon elements of in-stream wood production, short- and long-term.

One management option to address the current Riparian Reserve situation is to thin riparian zones, emphasizing treatment in plantations and dense second-growth forest. The theory is that thinning will increase the rate of large tree growth, thereby accelerating the trajectory of recovery towards desired condition, and eventually lead to larger and more numerous in-stream wood debris. Due to the long time-frame to observe a response under experimental conditions, studies are nearly non-existent and land managers often must rely upon model-based research.

Spies, *et al.* (2013) reviewed the current state of knowledge of the effects of riparian thinning in the Pacific Northwest. Literature, models, and the few experimental studies were reviewed. As to be expected, the ultimate effect of thinning in the development of larger diameter trees is dependent upon species, stand density and age, and various site-specific conditions. In general, the best candidates to respond favorably are moderately dense plantations and naturally regenerated stands which are 30 to 50 years old. The key consideration is that thinning should occur for a given species or species composition in the decades when the stem/crown growth is highest, thusly imparting the greatest influence on the diameter of future trees via the reduction of density dependent competition. Riparian thinning has the potential to moderately accelerate by 1 to 20 years (over a century) the appearance of very large diameter trees (>40 inches) relatively to unthinned plantations, a size class most desirable for in-stream fish habitat. However, thinning can also reduce the number of large standing dead available for recruitment, not only short-term due to harvest, but also long-term because the stand is healthier, thereby decreasing the incidence of mortality due to density dependent competition or disease. In other words, trees may reach the larger size classes faster, but they will also tend to live longer, with the subsequent delay in their

recruitment. Furthermore, recruitment of smaller wood classes also declines following thinning treatments. For fish, the effects of riparian thinning is dependent upon location: sites along headwater streams not prone to debris flows tend to have less effect than locales immediately adjacent to fish-occupied waterways or headwater systems which are more prone to catastrophic wood and sediment transport.

Ruzicka (2014) looked at the influence of thinning on the development of riparian trees. Growth response within an unthinned riparian buffer was found to be limited to about 50 feet (15 meters) of the treatment edge. Magnitude of response was also observed to be site-specific. A decrease in density dependent interactions, such as increased access to light and nutrients, was identified as a likely driver for increased growth. It is hypothesized that the observed spatial limit in growth response is a result of the density dependent interactions propagating only so far into an untreated riparian area from the treatment boundary.

In summary, the knowledge of how thinning in riparian area and nearby uplands affects tree growth and, ultimately, overall riparian health and long-term large wood input is still evolving. While it appears that treatments can improve growth of riparian trees, there are multiple questions, such as how site specific conditions can affect response; how far responses may propagate into untreated areas; and how aggressive a thin treatment is required to elicit a response. There are also caveats emerging regarding the best stand density and age window for treatment. As additional field data is gathered from long-term studies and models mature, then the circumstances whereupon thinning does beneficially affect riparian health will be refined.

Riparian thinning is not done in vacuum, and buffers are often needed to protect streambanks, act as a sediment buffer, and maintain microclimate conditions. The latter is especially important in fishless headwater streams for insects and small animals where fish-driven riparian protections may not directly apply. The use of buffers can counter some of the negative effects of thinning in regards to short- and moderate-term wood supply where buffers are set at a stand-applicable distance which best captures local expectations of recruitment (Benda, *et al.* 2015; Spies, *et al.* 2013). For instance, it may not be appropriate to set a no-treatment buffer at 150 feet (i.e., the site-potential of a mature tree) when the average tree height of a target plantation stand is 80 feet if the goal was to minimize in-stream impacts to the existing wood supply. Modeling by Benda, *et al.* (2015) suggests a 2/3 tree height is sufficient to maintain wood recruitment at 95 percent. Therefore, for the example above, an appropriate minimum buffer for a plantation with 80 foot trees is about 50 feet. However, the requirements of other species and resources may further inform the needed width of a no-treat riparian buffer beyond the aspect of maintaining wood recruitment.

Lover's Canyon Project harvest and silviculture treatments may have a short-term negative effect to Riparian Reserves, but are expected to impart a long-term benefit. Short-term effects to separate elements which comprise Riparian Reserves have been discussed in prior subsections, including "Substrate/Sediment", "Disturbance History and Regime", and "Large Woody Debris". Long-term benefits to the riparian and near-riparian uplands within the Riparian Reserve will require decades, if not more than a century, to become noticeable. Additionally, stand-specific gains in riparian health are expected to be greatest in units (harvest and pre-commercial thin) associated with fishless headwaters. This is because the larger buffer adjacent to fish-occupied creeks will maximize the retention of existing conditions, including stand density and current/future wood recruitment. Project-related vegetation treatment benefits beyond the first site-potential tree width are likely to remain insignificant to negligible in regards to adjacent fish

habitat. Instead, the no-treatment portion of these Riparian Reserves must either rely on natural processes to move towards desired condition, else assistance via the introduction of prescribed fire (discussed below). On the landscape scale, the long-term benefit to Riparian Reserves will be increased resiliency to stochastic permutations – flood, fire, climate change – in sustaining overall riparian functionality.

Prescribed Burn

Prescribed fire will be used within the Project area. Treatments will include handpile burning and underburning, the latter of which has the potential to affect Riparian Reserve condition. Potential underburn impacts to the individual Indicators which comprise Riparian Reserves have already been discussed in their respective subsections. Instead, the focus here is on the riparian condition as a whole. Two recent studies which examine response riparian and stream environment to prescribed fire have been described previously within this document.

- Arkle and Pilliod (2010) concluded prescribed fire, as currently practiced by the Forest Service in the western United States, does not serve as an effective surrogate mimicking disturbance in areas which include a natural history of riparian fire. Treatments are generally built so that fire severity within a riparian corridor will be minimal and impacts to aquatic habitat negligible. This means that the purpose assigned to most underburn programs – re-establish a natural fire regime, decrease fuel loading – is not being met within the riparian zone. By stating that disturbance to the stream system and habitat corridor would have to be much greater (e.g., higher fire intensity; more riparian area burned) for an effect outside of natural annual variation to be observed, it is suggested that land managers could potentially employ more aggressive riparian treatments with minimal short-term negative impacts to aquatic resources.
- Beche, *et al.* (2005) employed more aggressive-than-standard prescribed fire treatment, achieving low- to moderate-severity within the riparian zone. While protocols were otherwise consistent for a fall burn, the exception included active riparian ignition. Despite the resultant increased severity and achievement of the standard underburn goal to significantly reduce understory vegetation, there was no to little response in the biotic/abiotic elements which can affect fish and fish habitat.

Prescribed fire in the Riparian Reserve is expected to impart minimal effect to aquatic habitat, including Coho and Coho CH. While treatments will undoubtedly have some utility in removing undergrowth and excess fuels, overall underburn behavior within the riparian corridor is expected to be similar to that observed by Arkle and Pilliod (2010). In the outer edges of the Riparian Reserve, where riparian vegetation transitions to upslope species, and along drier headwater channels, treatments are expected to be more successful. However, within perennial riparian corridors, including those occupied by fish, it would require changes in protocol to be more aggressive, as per Beche, *et al.* (2005), to better address ecosystem alterations resulting from decades of fire suppression. Because the Project is unlikely to re-establish the natural fire regime or profoundly decrease fuel loading within riparian corridors associated with fish habitat, the fire regime component contributing towards Riparian Reserve degradation on the landscape scale within the Project area is expected to remain unchanged or be insignificantly benefitted.

Water Drafting

Water drafting will involve use of existing access roads and approaches. Brushing, grading, and rocking of existing access roads and approaches will have effects on Riparian Reserves that

remain confined to road prisms and immediately adjacent vegetation. Brushing of approaches will provide for vehicle passage only, and will therefore not significantly alter effective canopy shade in Riparian Reserves. There will be no long-term effects to Riparian Reserves from drafting because all effects associated with use of drafting sites will be localized, short term, and occur solely at existing sites. Therefore, water drafting may have insignificantly small localized effects, but will not affect the functional level of the Riparian Reserve indicator.

Summary

Project activities will have both a short-term and a long-term effect to Riparian Reserves. In the short-term, individual components which comprise the Riparian Reserve Indicator will impart insignificant, mostly localized, effects which will not alter the functional level of the Riparian Reserve in the Project area. In the very long-term, harvest and silviculture treatments may provide a landscape-scale benefit to Riparian Reserves in the form of larger trees and increased size of in-stream wood. However, this positive may be offset by prescribed fuels treatments which are insufficiently aggressive to fundamentally modify the existing riparian condition of altered fire regime. Therefore, it is the professional judgement of the Fish Biologist that the long-term effect to Riparian Reserves is neutral.

--Lamprey--

For lamprey, indirect effects to habitat are anticipated to be similar to those listed for salmonids. Additional focus herein is upon changes in substrate composition and the potential effect to ammocoetes (larvae). Because the larvae of both lamprey species require patches of soft sand or mud in which to burrow, actions that decrease these materials has the potential to affect local distribution and abundance of ammocoetes. However, such is unlikely to occur as a result of the Project. As analyzed for salmonids, alteration to substrate composition is not expected. Therefore, material suitable for ammocoete rearing will continue to be available.

More important than the effect of individual project components to lamprey is the effect of the Project to stream habitat as a whole. Maintenance of lamprey habitat and abundance best occurs in a heterogeneous system, one which encompasses complex instream features at multiple spatial scales (Torgensen and Close 2004). The Project will maintain a complex habitat for salmonids; and in doing so, will also benefit lamprey at all life stages.

--Killer Whale (Orca)--

Killer whale (Orca) are marine mammals, and the largest members of the dolphin family. The southern resident population is recognized as the J, K, and L pods, normally found in the inland waterways of Washington state and the transboundary waters between the United States and Canada. Recent satellite tagging has shown that some members of the southern population may be found as far south as central California during the winter months. Southern resident Orca are fish-eaters. Therefore, potential prey fish of interest would be anadromous salmonid species such as Coho salmon, Chinook salmon, and steelhead. Activities which measurably affect availability of these species as food could lead to an impact to Orca.

This Aquatic Resource Report concludes effects to anadromous fish habitat to be insignificant; and there is no expectation of mortality at any life stage. A summary of potential Project effects upon fish is provided at the end of this document. For killer whale, this Project will not result in lethal take of anadromous fish nor contribute to long-term detrimental alteration in habitat such that the production of anadromous food-fish species availability for Orca will be affected.

Table 7. Summary of the effects of each Indicator on salmonid fish of Alternative 2 of the Lover's Canyon Project for project element/indicator combinations. Bolded Indicators potentially impact fisheries resources and are analyzed further in the text. Indicator applies to both anadromous and resident fish, unless specified otherwise.

Indicators	Harvest (Tractor, Skyline, Endline)	Non-Commercial	Fuels Treatments	Comments
Temperature	-/0	0	0	Insufficient change in effective stream shading (vegetation treatments) or flow (drafting) to affect fish-occupied waters (USFS 2016b); **see text for further discussion**
Turbidity	0	0	0	No net change in sediment input to fish-occupied streams; CWE models remain below threshold or do not contribute to overthreshold conditions (USFS 2016b,d); **further analysis provided for drafting and legacy treatments**
Chemical Contamination	0	0	0	No chemical treatments will be used; BMPs for fuel use and equipment operation setbacks from streams.
Nutrients	0	0	0	No fertilizers or nutrient treatments will be used and equipment setbacks from streams
Physical Barriers	0	0	0	No barriers removed or constructed
Substrate	-/0	0	0	No measurable sediment impacts to fish-occupied streams from Project activities (USFS 2016b,d); **see text for further discussion**
Large Woody Debris	-/0	-/0	-/0	No LWD removal within RR; application of RMPs to burn prescriptions. **Further discussion is provided** concerning wood recruitment and transport downstream, especially in regard to commercial harvest units.
Pool Frequency and Quality	0	0	0	No change in flows or sediment delivery
Off-Channel Habitat	0	0	0	Not present or Project activities are not adjacent to habitat
Refugia	0	0	0	No change in ability of habitat to support and/or connect fish populations
Width/Depth Ratio	0	0	0	No change in sediment input; geomorphology will not be affected (USFS 2016b,d)
Streambank Condition	0	0	0	Mechanical treatment units are set back from streams; drafting will use existing access points; other actions as per RMPs
Floodplain Connectivity	0	0	0	No change in flows or sediment delivery
Change in Peak/Base Flows	0	0	0	Insufficient change in ERA to affect flows (USFS 2016b,d); **further analysis provided for drafting**
Increase in Drainage Network	-/+	0	0	Landing/skid trail construction, temporary road/trail rehabilitation, and legacy site rehabilitation - **analysis provided.** Other Project elements will not affect the drainage network
Road Density and Location	0	0	0	No new roads will be constructed. Temporary routes will be closed and hydrologically stabilized, as needed.
Disturbance History and Regime	-/0	0	0	Increase in disturbance and erosion indices (USFS 2016b,d); **further analysis provided**
Riparian Reserves	-/+	0/+	0	While long-term desired RR character will not be detrimentally altered, there may be short-term effects from multiple Project activities; **see text for further analysis**

0 = Neutral effects
- = Insignificant or discountable negative effects
+ = Insignificant or discountable positive effects
S-= Significant negative effects
S+ = Significant positive effects
/ = Short-term/long-term effects

Table 7, cont. Summary of the effects of each Indicator on salmonid fish of Alternative 2 of the Lover's Canyon Project for project element/indicator combinations. Bolded Indicators potentially impact fisheries resources and are analyzed further in the text. Indicator applies to both anadromous and resident fish, unless specified otherwise.

Indicators	Prescribed Underburn	Water Drafting	Legacy Treatments	Comments
Temperature	-/0	-/0	0	Insufficient change in effective stream shading (vegetation treatments) or flow (drafting) to affect fish-occupied waters (USFS 2016b); **see text for further discussion**
Turbidity	0	-/0	-/0	No net change in sediment input to fish-occupied streams; CWE models remain below threshold or do not contribute to overthreshold conditions (USFS 2016b,d); **further analysis provided for drafting and legacy treatments**
Chemical Contamination	0	0	0	No chemical treatments will be used; BMPs for fuel use and equipment operation setbacks from streams
Nutrients	0	0	0	No fertilizers or nutrient treatments will be used and equipment setbacks from streams
Physical Barriers	0	0	0	No barriers removed or constructed
Substrate	-/0	0	-/+	No measurable sediment impacts to fish-occupied streams from Project activities (USFS 2016b,d); **see text for further discussion**
Large Woody Debris	0	0	0	No LWD removal within RR; application of RMPs to burn prescriptions. **Further discussion is provided** concerning wood recruitment and transport downstream, especially in regard to commercial harvest units.
Pool Frequency and Quality	0	0	0	No change in flows or sediment delivery
Off-Channel Habitat	0	0	0	Not present or Project activities are not adjacent to habitat
Refugia	0	0	0	No change in ability of habitat to support and/or connect fish populations
Width/Depth Ratio	0	0	0	No change in sediment input; geomorphology will not be affected (USFS 2016b,d)
Streambank Condition	0	0	0	Mechanical treatment units set back from streams; drafting will use existing access; other actions as per RMPs
Floodplain Connectivity	0	0	0	No change in flows or sediment delivery
Change in Peak/Base Flows	0	-/0	0	Insufficient change in ERA to affect flows (USFS 2016b,d); **further analysis provided for drafting**
Increase in Drainage Network	0	0	+/+	Landing/skid trail construction, temporary road/trail rehabilitation, and legacy site rehabilitation - **analysis provided.** Other Project elements will not affect the drainage network
Road Density and Location	0	0	0	No new roads will be constructed. Temporary routes will be closed and hydrologically stabilized, as needed.
Disturbance History and Regime	0	0	0	Increase in disturbance and erosion indices (USFS 2016b,d); **further analysis provided**
Riparian Reserves	-/0	-/0	0	While long-term desired RR character will not be detrimentally altered, there may be short-term effects from multiple Project activities; **see text for further analysis**

0 = Neutral effects
- = Insignificant or discountable negative effects
+ = Insignificant or discountable positive effects
S-= Significant negative effects
S+ = Significant positive effects
/ = Short-term/long-term effects

Cumulative Effects

Cumulative effects analysis under NEPA:

> Focus includes past and foreseeable Federal actions, as well as incorporation of non-Federal activities. To understand the contribution of past actions to the cumulative effects of the proposed action, this analysis relies on current environmental conditions as a proxy for the impacts of past actions. This is because existing conditions reflect the aggregate impact of all prior human actions and natural events that have affected the environment and might contribute to cumulative effects.

Cumulative effects analysis for ESA is a subset of the NEPA analysis and is focused upon Endangered, Threatened, and Candidate species. The ESA cumulative effects analysis is located in the Project Biological Analysis document.

NEPA Cumulative Effects

Within the Project area, there are no foreseeable non-Federal (i.e., private or State) actions planned or undergoing implementation at the time of this document.

Future foreseeable Federal actions include (1) Lake Mountain and Middle Tompkins Grazing Allotment Management Plan (new project); (2) Westside Fire Recovery (continued implementation); (3) Scott Bar Mountain Underburn and Habitat Improvement Project (continued implementation); and (4) Woolley Water/Road Special Use Permit Renewal.

(1) The Lake Mountain-Middle Tompkins (LMMT) Allotment Management Plan project will re-authorize livestock grazing upon two allotments. General location includes the drainages of Tompkins Creek, Middle Creek, several Grider Creek headwater streams, and multiple small watersheds which drain to the Klamath River between Scott River and O'Neil Creek. The project is currently in the latter stage of planning – analysis/consultation (including fisheries) is complete, with the Environmental Analysis document being finalized in preparation for a decision.

The LMMT allotment nearest the Lover's Canyon project area is Middle Tompkins. The physical footprint of the two projects do not overlap and only one 7th-field watershed is shared – Deep Creek-Scott River. Only 240 allotment acres are within the shared watershed; and of those, only 20 acres (mid-slope) are considered capable of supporting grazing use. Historical livestock observations – no animals are currently present – suggest use in this portion of the allotment is minimal to non-existent due to a lack of both forage and accessible water. Therefore, no cumulative effects are expected because even if cattle do use allotment land within the Deep Creek-Scott River watershed, it will be transient and have no measurable effect on the landscape scale within the consideration of the CWE models (USFS 2015d).

(2) Within the Project area, a future foreseeable Federal action is continued implementation of the Westside Fire Recovery Project. This project is a response to the 2014 wildfires which occurred on the KNF, including the Happy Camp Complex within and adjacent to the Lover's Canyon project. The Westside project will include the following actions – salvage timber harvest, hazardous fuels reduction, fuel break construction/maintenance, hazard tree removal, and site preparation and replanting. Treatment of legacy sites – locations that exhibit an elevated level, or risk thereof, of erosion, especially finer sediments, as a result of past or existing human activities – will also occur. Elements of this complex, multi-year project began in 2016.

Activities of the Westside Fire Recovery project will minimally intersect with the Lover's Canyon project. Boundaries overlap, but there is no physical overlap of units. Because there is no spatial overlap of actions, such as similar road use or sharing of drafting sites, there will be no potential for additive disturbance via this vector. Both projects do have actions planned in the 7th-field watersheds of Deep Creek-Scott River, North Fork Kelsey Creek, and South Fork Kelsey Creek. Westside Fire Recovery actions within the listed watersheds include all project activities except salvage harvest.

Potential cumulative interactive effects in regards to the two projects would be via landscape-scale disturbance as evaluated by the CWE models. Of note, the one component of potential concern – Deep Creek-Scott River, GEO model – had been above the "1" risk threshold before the fire. Due to road treatments and natural recovery from past harvest, the Deep Creek-Scott River watershed had been in a long-term trajectory of improvement pre-fire; and the low percentage of moderate/high burn severity resulting from the Happy Camp Complex were not sufficient to reverse that trend. Subsequent Westside project actions within the three shared watersheds add minimally or not at all to post-fire CWE model risks (USFS 2015e). Because the Westside project is considered a current/existing action with implementation expected to be underway by the time the Lover's Canyon analysis was complete, it was included in CWE modeling. There will be insufficient cumulative effect to exceed CWE model thresholds in shared drainages, nor substantially amplify those metrics already over threshold.

(3) Another foreseeable Federal action within the Project area is continued implementation of the Scott Mountain Underburn and Habitat Improvement project. This is a multi-year project which began in 2015. Activities to occur include fuel break construction and underburning. The schedule for implementation is dependent upon weather conditions and personnel availability.

The physical footprint of the Scott Mountain Underburn project does not overlap with the Lover's Canyon project. However, two 7th-field watersheds are shared – Deep Creek-Scott River and Isinglass Creek-Scott River. No cumulative impact is expected. As there is no spatial overlap of actions, such as prescribed burning or sharing of drafting sites, there will be no potential for additive disturbance. Furthermore, because the Scott Mountain Underburn project has been analyzed and is being actively implemented, it is considered a current/existing action already included in pre-Project CWE modeling.

(4) The last foreseeable Federal action within the Project area is the Woolley Water/Road Special Use Permit Renewal. Although considered a "new" project, this action will renew an existing water transmission line and use of a Forest Road as a private residential driveway. Current use and maintenance of the water line and road will not change as a result of the permit renewal. This action is within a Project 7th-field watershed (Isinglass Creek-Scott River), but is outside the footprint of the Project; and no new disturbance will occur. For these reasons, no cumulative effect will occur in conjunction with the Lover's Canyon Project and the permit renewal.

Finally, while past events within the Project area – e.g., mining, timber harvest, road building, grazing, flood, fire – contribute to the existing condition, this Project will not produce an additive effect. Specifically concerning grazing, while there is an allotment ("Marble Mountain") that overlaps the Project area, under current management practices, livestock are grazed within the Wilderness or near the Wilderness boundary. The main gathering corral is located near Lovers Camp trailhead; and livestock are rarely seen outside of the Wilderness except when animals are being herded to/from a private corral across the Scott River from Indian Scotty

Campground. Livestock use patterns, including herding to/from the Wilderness, are not expected to change as a result of Project activities: minimal transient range near livestock use areas will be created by silviculture and/or prescribed fire to attract animals; and what is created will return to its pre-Project conditions within a few years.

In summary, there will be minimal cumulative impacts to aquatics from current and reasonably future foreseeable projects within the vicinity of the Lover's Canyon Project. Cumulative impact occurs when the effects of one project overlaps with or compound the effects of another. In the Lover's Canyon Project area, although projects may overlap Project boundaries (Westside Fire Recovery), and/or share a common watershed without physical boundary overlap (Lake Mountain-Middle Tompkins Allotments, Scott Mountain Underburn, Woolley Water/Road Permit Renewal), there will be no significant adverse additive effects to aquatic habitat Indicators. Cumulative Watershed Effects models either remain below the threshold of concern, else are not exasperated, when the effects of the Lover's Canyon Project and all current and future foreseeable projects are included in the model.

Alternative 3

Direct and Indirect Effects

Alternative 3 differs from Alternative 2 in regards to magnitude of impact.

Adjustment of treatments within commercial units to create larger skip areas to leave a higher level of structural diversity post-treatment, thereby reducing short-term effects to northern spotted owl habitat, will not measurably affect fisheries resources. The majority of units affected by this alternative are located upslope and distant from fish-bearing streams. Units modified under Alternative 3 with fish-occupied Riparian Reserves include:

- Unit 526-110 (anadromous) – this skyline unit was previously discussed in Alternative 2 to be disconnected from Canyon Creek in regards to Project actions within Riparian Reserves. Therefore, harvest treatment adjustments, if any occur within mapped Riparian Reserves, are not expected to provide measurable benefit to aquatic resources.
- Units 524-054 and 524-055 (resident rainbow trout) – these skyline units, respectively, involve no or minimal harvest within Riparian Reserves (see **Appendix A** and Alternative 2 discussion). Because harvest treatment adjustments are expected to occur outside Riparian Reserves, a measurable benefit to aquatic resources is not expected.

There will be no changes to the post-Project cumulative watershed effects (**Table 4**) because prescription modifications are of insufficient size and intensity to be modeled on the landscape level.

The direct and indirect effects for all connected actions – landings, temporary roads, water drafting, legacy sites – will remain the same as Alternative 2.

Cumulative Effects

Cumulative effects will be the same as described under Alternative 2.

Summary of Effects

Potential direct impacts to aquatic resources may occur as a result of water drafting. No other Project elements include instream activities within fish-bearing waters. Fish screens, resource protection measures/BMPs, and fish mobility will preclude impingement. Fish temporarily avoiding water drafting activities are not likely to experience reduced feeding success, nor result in a significantly higher probability of exposure to predators.

Potential indirect impact to aquatic resources will occur as a result of harvest and silviculture activities, prescribed fire, legacy site treatment, and water drafting. Most effects will be localized, insignificant, and short-term and will impart no meaningful impact to fish or fish habitat, including Coho and Coho Critical Habitat. The majority of project activities are mid-slope, on ridges, or adjacent to fishless streams distant from fish-occupied waters. The use of resource protection measures/BMPs, along with distance, will mitigate most potential impactors to aquatic resources to nondetectability from background natural variation. While CWE models will be affected by Project actions, they will either remain below critical threshold or not contribute to over-threshold risks**.** Finally, there will be insignificant beneficial effects due to treatment of legacy sites and post-Project rehabilitation of temporary roads; and Riparian Reserve condition in some locations may also benefit in the long-term in the form of larger trees and increased size of in-stream wood.

There will be no indirect impacts to Killer Whale (Orca) because the Project will not result in lethal take of anadromous fish nor contribute to long-term detrimental alteration in habitat such that the production of anadromous food-fish species availability is affected.

Therefore, the Fish Biologist has reached the following determination (applies to both Action Alternatives because effects are similar):

Table 8. Summary of findings for Threatened/Endangered species, Sensitive species, and Management Indicator Species. Determination applies to both Action Alternatives because effects are similar.

Species	Special Status	[1]Determination
Fishes		
Coho Salmon (and CH)	Federally Threatened	NLAA
Chinook Salmon (Spring/Fall runs) (Upper Klamath-Trinity Rivers)	FSS	MANL
Steelhead Trout (Klamath Mountains Province)	FSS, MIS	MANL
Rainbow Trout (resident)	MIS	MANL
Pacific Lamprey	FSS	MANL
Klamath River Lamprey	FSS	MANL
Mammal		

Species	Special Status	[1]Determination
Killer Whale (Orca)	Federally Endangered	NE
Other Habitat		
Essential Fish Habitat (Coho/Chinook)		Will not adversely affect

[1]Federally Listed Species
NE - Will not affect the species or its Critical Habitat
NLAA - May affect, not likely to adversely affect the species or its Critical Habitat
LAA - May affect, likely to adversely affect the species or its Critical Habitat

Forest Sensitive Species (FSS) / Management Indicator Species (MIS)
NE - No effect to the species (FSS and MIS)
MANL - May affect individuals, but is not likely to lead to a trend towards listing (FSS); and/or
May affect individuals, but is not likely to lead to a decreasing population trend (MIS)
MALT - May affect individuals, and is likely to result in a trend towards listing (FSS); and/or
May affect individuals, and is likely to lead to a decreasing population trend (MIS)

There will be no long-term change in the baseline functionality of analysis Indicators. While there may be an insignificant benefit for Substrate/Sediment, Drainage Network, and Riparian Reserves under either Alternative, it will not be sufficient to change the existing condition.

Table 9. Indicator summary for Lover's Canyon Project alternatives.

Indicator	Alternative 1 (no action)	Alternative 2	Alternative 3
Temperature	0	-/0	-/0
Substrate/Sediment	0	-/+	-/+
Turbidity	0	-/0	-/0
Large Woody Debris	0	-/0	-/0
Disturbance History/Regime	0	-/0	-/0
Peak/Base Flow	0	-/0	-/0
Drainage Network	0/-	-/+	-/+
Riparian Reserves	0	-/+	-/+

0 = Neutral effects
- = Insignificant or discountable negative effects
+ = Insignificant or discountable positive effects
S-= Significant negative effects
S+ = Significant positive effects
/ = Short-term/long-term effects

Compliance with law, regulation, policy, and the Forest Plan

All Alternatives will meet Forest Plan Standards and Guides, Endangered Species Act, Magnuson-Stevens Fishery Conservation and Management Act, Northwest Forest Plan, and all other relevant regulations, laws, and policies. Section 7 consultation will be completed with the National Marine Fisheries Service.

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Report Summary

Methodology

Analysis Indicators and Measures

The analysis of the potential effects to fish and their habitat is organized by direct and indirect effects and by effects to seventeen Indicators of anadromous fish habitat conditions. The Indicators originate from the "Analytical Process for Developing Biological Assessments for Federal Actions Affecting Fish within the Northwest Forest Plan Area" (USDI, USDA, and NOAA 2004). Effects of project elements to an Indicator may be neutral (no effect), discountable (extremely unlikely to occur), insignificant (effects are not able to be meaningfully measured, detected, or evaluated), or significant (effects able to be measured). Furthermore, effects may be either positive or negative. After the appropriate Indicators have been evaluated, the resulting information is used to determine overall effects on aquatic species, including Coho Critical Habitat and Essential Fish Habitat.

Although the methodology for effects analysis only technically applies to anadromous fish within the Project area (e.g., Coho, Chinook, and steelhead), for this report it is also used for resident rainbow trout to ensure a consistent assessment of fish species; and indirect effects to anadromous fish will serve as a proxy for lamprey. Additionally, Indicators are used to assess the existing environment of anadromous systems, with each Indicator labeled as to if it is "Properly Functioning," "Functioning-At-Risk," or "Not Properly Functioning" for a given stream.

Of the seventeen total Indicators, the following are potentially affected by the Project and will undergo further discussion:

- Temperature
- Sediment/Substrate
- Turbidity
- Large Woody Debris
- Disturbance History/Regime
- Peak/Base Flows
- Drainage Network
- Riparian Reserves

Temperature – Is rated by stream temperature, and the expected change from the existing condition due to Project activities.

Sediment/Substrate – Is rated by percentage of substrate composition of finer material. Considered data can include composition of surface and subsurface of non-pool units, as well as volume of pools filled with fines. Where no or limited survey data is available, evaluation may utilize Cumulative Watershed Effects (USLE/GEO) models and professional judgment.

Turbidity – Is rated by professional judgment following observation of conditions after high water events, amount of substrate fines, Cumulative Watershed Effects models (USLE/GEO), and condition of Riparian Reserves. In addition, the distance to fish habitat and the likelihood of activities to introduce fine sediment into fish-bearing streams will also be incorporated into the effects analysis.

Large Woody Debris – Is rated using amount of "large wood" per linear length of stream; and is only applicable in 3rd or larger order stream systems. The Northwest Forest Plan and KNF Land Resource Management Plan offer guidelines as to an acceptable amount of wood, as well as provide definitions of "large wood". If professional judgment concludes guidelines are inadequate or do not capture the nature of the system under consideration, channel width and potential of the site to produce and retain woody debris may be used. Potential for future large woody debris recruitment in both short- and long-term should also be considered. Recruitment will be determined using the likelihood of the removal of standing trees that have a high probability of becoming large woody debris in the stream channel based on professional judgment and scientific literature.

Disturbance History/Regime – Is primarily rated using Cumulative Watershed Effects models. If professional judgment concludes that these models are not fully capturing disturbance risk, road density and location, current impacts from past stand-replacing timber harvest and wildfire, fire regime, vegetation regime, and development on private property may also be considered.

Peak/Base Flows – For watershed-level, this Indicator is rated using elements of Equivilant Roaded Area model, road density, vegetation and Riparian Reserve condition, and other associated components. Any potential effects to flows due to a site-specific Project element are considered individually.

Drainage Network – Is rated by increase/decrease in drainage network as related to roads, ditches, and other similar structures.

Riparian Reserves – Is a consideration of the riparian environs, and extending into the near uplands. It is rated as a synthesis of shade; large woody debris recruitment; disturbance, roading, and other impacts to the Riparian Reserve management zone.

Spatial and Temporal Bounding of Analysis Area

The analysis area for aquatic resources includes effects at the site-specific and watershed-scale extent. Watersheds utilized in the analysis are at the 5th- and 7th-field level. Site-specific analysis discussion will focus on water drafting within the range of anadromous and resident fish. For the remainder of the Project area, Project components are outside the distribution of analysis species, habitat is not present, and/or distance to occupied/suitable habitat is too distant for an effect to occur.

Temporal analysis timeframe includes effects during implementation, short-term effects expected to occur within the first year following implementation, and long-term effects (greater than one year).

Affected Environment

The Lover's Canyon Project is situated west of the town on Fort Jones and south of the Scott Bar community. The Project is located south of the Scott River, in the general vicinity of Indian Scott Campground, and within the non-Wilderness portions of Boulder Creek, Canyon Creek, and Kelsey Creek drainages. Several fish-bearing streams are potentially affected by the Project: Scott River, Boulder Creek, Canyon Creek, Kelsey Creek, and SF Kelsey Creek. Additionally, there are many fishless drainages (intermittent and perennial) within the Project area.

The only Threatened or Endangered fish in the analysis area is the Southern Oregon/Northern California Coasts Coho salmon (*Oncorhynchus kisutch*), including Critical Habitat. Sensitive fish species for the Klamath National Forest in the Project are the Upper Klamath-Trinity Rivers Chinook (*Oncorhynchus tshawytscha*), Klamath Mountains Province Steelhead (*Oncorhynchus mykiss*), Klamath River lamprey (*Entosphenus similis*), and Pacific lamprey (*Entosphenus tridentatus*) Both steelhead and resident rainbow trout (*Oncorhynchus mykiss*) are management indicator species in the Forest Plan. Additionally, Essential Fish Habitat designation is associated with Coho salmon and Chinook salmon. The National Marine Fisheries Service has requested action agencies, including the KNF, to consider project impacts on species preyed upon by Endangered Species Act-listed killer whale (*Orcinus orca*).

Summary of actual and potential occupancy by analysis species of creeks/rivers within 7th- and 5th-field watersheds:

Species	7th-Field				5th-Field
	Boulder Creek	Canyon Creek	Kelsey Creek	SF Kelsey Creek	Scott River
Coho	T	X, T	X, T		X
Chinook	T	X, T	X, T		X
Steelhead	T	X, T	X, T		X
Resident Rainbow Trout	X	X	X	X	X
Pacific Lamprey		P	P		X
Klamath River Lamprey		P	P		X

X - confirmed present
P - potential presence
T - thermal refugia

For the analysis Indicators, baseline existing condition – "Properly Functioning", "Functioning-at-Risk", and "Not Properly Functioning" – applies principally to creeks which directly or indirectly support anadromous species. "Direct" can include spawning and/or rearing habitat; and "Indirect" may refer to providing a recognized cold-water thermal refugia. Because the analysis process focuses on anadromous species and their habitat, a baseline condition is not required for SF Kelsey Creek, a resident rainbow-only system. However, it is the opinion of the Fish Biologist that its overall condition generally aligns with Kelsey Creek, which does support anadromous fish.

Baseline for analysis Indicators for anadromous streams in the Project area:

Stream/River	Temperature	Substrate	Turbidity	Large Woody Debris	Dist. History/Regime	Peak/Base Flows	Drainage Network	Riparian Reserves
Boulder Creek	P	P	P	NF	P	P	P	FAR
Canyon Creek	P	P	P	NF	P	P	P	FAR
Kelsey Creek	P	P	P	NF	P	P	FAR	FAR
Scott River	NF	NF	FAR	NF	FAR	NF	FAR	FAR

P - "Properly Functioning"
FAR - "Functioning-at-Risk"
NF - "Not Properly Functioning"

Environmental Consequences

Alternative 1 – No Action

Direct Effects and Indirect Effects

Under the No Action alternative, the Project will not happen and no management actions will be taken. As a result, legacy sites identified for the Lover's Canyon Project will not be addressed.

Legacy sites identified for the Lover's Canyon Project will not be treated. The effect to fish and fish habitat of not addressing these sites could range from not measurable to significant, depending upon the scenario and the species considered. The majority of locations are considered to be "low-risk" or "moderate-risk", whereupon current or potential sediment impact to their respective watershed is minimal. However, there are also multiple "high-risk" sites: the nearest location with elevated risk is about 250 feet from resident rainbow trout habitat, and more than one mile for anadromous habitat. The greatest potential for detrimental impact would occur if a large storm (100-year event or larger) affected the Project area, with the worst-case scenario of all legacy sites failing.

The impact to fish habitat from sediment produced due to failure of legacy sites is unknown. All major streams in the Project area, with the exception of Scott River, are considered to have good baseline water quality. If a single or several sites were to experience catastrophic failure the impact downstream is likely to be minimal and short-term. In the event of all sites failing concurrently, the amount of sediment released would be additional to that which would be naturally produced through other means, such as landslides. While there are multiple legacy sites throughout the Project area, most are distant from fish-occupied waters and/or require extensive overland movement of sediment to reach a waterway. Where sites are near fish-occupied waters, rainbow trout, particularly those found in SF Kelsey Creek, are at greatest risk for habitat alteration due to close proximity. Anadromous habitat is more distant from legacy sites; and while storm-related impacts are likely to occur, it would be difficult to separate sediment originating from natural and anthropogenic sources.

Cumulative Effects

Cumulative impact occurs when the effect of one project overlaps with or compounds the effects of another. The Lover's Canyon Project does not influence the implementation of any nearby project, nor visa-versa. The primary consequence to fish and aquatic habitat of not doing the Project is related to legacy site impacts. However, the legacy site risk is part of the existing baseline; and because the other projects are physically separate from Lover's Canyon Project, their activities will neither influence nor exacerbate the existing condition. Therefore, without direct effects or a compounding indirect effect, there cannot be cumulative effects for the No Action Alternative.

Alternative 2

Direct Effects

Potential direct impacts to aquatic resources may occur as a result of water drafting. No other Project element include instream activities within fish-bearing waters. Fish screens, resource protection measures/Best Management Practices, and fish mobility will preclude impingement. Fish temporarily avoiding water drafting activities are not likely to experience reduced feeding success, nor result in a significantly higher probability of exposure to predators.

Indirect Effects

Potential indirect impact to aquatic resources will occur as a result of harvest and silviculture activities, prescribed fire, legacy site treatment, and water drafting. The indirect effects to Indicators which may be affected by Project activities are as follows:

Temperature – The project will have a minor, short-term effect to stream flow during water drafting operations. However, the effects are not likely to have any detectable change to stream temperature in fish-bearing reaches or have any meaningful impact to fish habitat, including thermal refugia. There will be no meaningful effect to stream temperature from commercial harvest or silviculture activities because effective stream shade will be maintained. Similarly, prescribed fire will not impact stream temperature because overstory riparian vegetation will be maintained.

Sediment/Substrate – Most sediment which is mobilized by Project activities is expected to remain localized near to the site of disturbance. Because there will be no measurable transport of sediment to fish-occupied areas above the background level, Indicators which directly or indirectly rely upon this metric (turbidity, pool frequency and quality, width/depth ratio, and floodplain connectivity) will not be affected. Due to the location of the Project upon the landscape, functionality of Riparian Reserve buffers, project design features, and Best Management Practices considered adequate to control overland movement of sediment, neither fish nor their habitat will be affected by changes to the sediment regime caused by Project activities.

Turbidity – Only work associated with legacy site repair and water drafting would occur within a stream channel, potentially creating turbidity. The amount of ground disturbance and associated stream turbidity likely as a result of the crossing upgrades is limited in scope and intensity. Legacy site activities which occur in association with stream channels are above habitat occupied by fish, and potential sediment generated from these activities is likely to be undetectable greater than 300 feet downstream of the site and therefore would not have any

meaningful effect to fish or their habitat. Where drafting sites are within fish-occupied waters, a small plume of suspended sediment is expected during operations, but turbidity will be localized, minimal in extent and duration, with the most likely fish behavior to be one of avoidance. No measurable increase in turbidity expected beyond the immediate area where drafting occurs.

Large Woody Debris – Effect to recruitment and transport of large woody debris of an appropriate size to affect habitat attributes of fish-bearing streams is not expected. Creeks with fish and fish habitat adjacent to harvest units will retain similar rates of current large woody debris recruitment due to buffer width. Where a decreased input of smaller debris may affect function of fishless headwater systems, the impact will be short-term, localized, and unlikely to be noticeable downgradient within fish-occupied reaches. In the long-term, benefits are expected throughout the Project area via the growth of larger trees which may contribute to future large woody debris input.

Disturbance History/Regime – While there are CWE model increases as a result of this Project, there will be no significant effects to aquatic habitat from any Project activities. Model estimates for ERA and USLE remain below the critical threshold; and estimates for GEO, while over threshold, are not appreciably increased as a result of the Project. Additionally, because all models remain below threshold or will not functionally change, Indicators which directly or indirectly utilize this metric (i.e., peak/base flows, floodplain connectivity, substrate, turbidity, and width/depth ratio) will not be measurably affected.

Peak/Base Flows – At the site level, there is potential for short-term, indirect effects downstream from water drafting locations. However, effects of water drafting are considered insignificantly small in regards to fish habitat due to resource protection measures/BMPs, short duration, and size of the creeks being utilized.

There will be no watershed-scale changes to peak/base flows as a result of Project activities due to treatment unit location on the landscape, minimal and localized impacts, and functioning buffering capacity of intervening Riparian Reserve habitat. This is reflected in ERA model output, which remains below the threshold of concern.

Drainage Network – In the short-term, there will be an insignificant increase in the drainage network temporary roads, landing, and skid trail construction, with these impacts neutral in the long-term due to subsequent rehabilitation and natural stabilization. Long-term, there will be an insignificant decrease in the drainage network following hydrologic stabilization of temporary roads and legacy sites repair.

Riparian Reserves – Project activities will have both a short-term and a long-term effect to Riparian Reserves. In the short-term, individual components which comprise the Riparian Reserve Indicator will impart insignificant, mostly localized, effects which will not alter the functional level of the Riparian Reserve in the Project area. In the very long-term, harvest and silviculture treatments may provide a landscape-scale benefit to Riparian Reserves in the form of larger trees and increased size of in-stream wood. However, this positive may be offset by prescribed fuels treatments which are insufficiently aggressive to fundamentally modify the existing riparian condition of altered fire regime. Therefore, it is the professional judgement of the Fish Biologist that the long-term effect to Riparian Reserves is neutral.

Cumulative Effects

There will be minimal cumulative impacts to aquatics from current and reasonably future foreseeable projects within the vicinity of the Lover's Canyon Project. Cumulative impact occurs when the effects of one project overlaps with or compound the effects of another. In the Lover's Canyon Project area, although other projects may overlap Project boundaries and/or share a common watershed without physical boundary overlap, there will be no significant adverse additive effects to aquatic habitat Indicators. Livestock grazing as an existing use is expected to change minimally, if at all, from current use patterns: any transient range created as a result of the Lover's Canyon Project is expected to return to pre-Project conditions within a few years of silviculture and/or prescribed fire operations. Finally, Cumulative Watershed Effects models either remain below the threshold of concern, else are not exasperated, when the effects of Alternative 2 and all current and future foreseeable projects are included in the model.

Alternative 3

Direct Effects and Indirect Effects

Alternative 3 differs from Alternative 2 in regards to magnitude of impact.

Adjustment of treatments within commercial units to create larger skip areas to leave a higher level of structural diversity post-treatment will not measurably affect fisheries resources. The majority of units affected by this alternative are located upslope and distant from fish-bearing streams. For the units adjacent to fish-occupied water, treatment adjustments within Riparian Reserves, if they occur, will be situated at least 170 feet from the creek. Furthermore, there will be no changes to the post-Project cumulative watershed effects because prescription modifications are of insufficient size and intensity to be modeled on the landscape level. Because of these reasons, a measurable difference in analysis conclusion as described for Alternative 2, is not expected.

The direct and indirect effects for all connected actions – landings, temporary roads, water drafting, legacy sites – will remain the same as Alternative 2.

Cumulative Effects

Cumulative effects will be the same as described under Alternative 2.

Summary of Effects

Potential direct impacts to aquatic resources may occur as a result of water drafting. No other Project elements include instream activities within fish-bearing waters. Fish screens, resource protection measures/BMPs, and fish mobility will preclude impingement. Fish temporarily avoiding water drafting activities are not likely to experience reduced feeding success, nor result in a significantly higher probability of exposure to predators.

Potential indirect impact to aquatic resources will occur as a result of harvest and silviculture activities, prescribed fire, legacy site treatment, and water drafting. Most effects will be localized, insignificant, and short-term and will impart no meaningful impact to fish or fish habitat, including Coho and Coho Critical Habitat. The majority of project activities are mid-slope, on ridges, or adjacent to fishless streams distant from fish-occupied waters. The use of resource protection measures/BMPs, along with distance, will mitigate most potential impactors

to aquatic resources to nondetectability from background natural variation. While CWE models will be affected by Project actions, they will either remain below critical threshold or not contribute to over-threshold risks**.** Finally, there will be insignificant beneficial effects due to treatment of legacy sites and post-Project rehabilitation of temporary roads; and Riparian Reserve condition in some locations may also benefit in the long-term in the form of larger trees and increased size of in-stream wood.

There will be no indirect impacts to Killer Whale (Orca) because the Project will not result in lethal take of anadromous fish nor contribute to long-term detrimental alteration in habitat such that the production of anadromous food-fish species availability is affected.

Therefore, the Fish Biologist has reached the following determination (applies to both Action Alternatives because effects are similar):

Species	Special Status	[1]Determination
Fishes		
Coho Salmon (and CH)	Federally Threatened	NLAA
Chinook Salmon (Spring/Fall runs) (Upper Klamath-Trinity Rivers)	FSS	MANL
Steelhead Trout (Klamath Mountains Province)	FSS, MIS	MANL
Rainbow Trout (resident)	MIS	MANL
Pacific Lamprey	FSS	MANL
Klamath River Lamprey	FSS	MANL
Mammal		
Killer Whale (Orca)	Federally Endangered	NE
Other Habitat		
Essential Fish Habitat (Coho/Chinook)		Will not adversely affect

[1]Federally Listed Species
NE - Will not affect the species or its Critical Habitat
NLAA - May affect, not likely to adversely affect the species or its Critical Habitat
LAA - May affect, likely to adversely affect the species or its Critical Habitat

Forest Sensitive Species (FSS) / Management Indicator Species (MIS)
NE - No effect to the species (FSS and MIS)
MANL - May affect individuals, but is not likely to lead to a trend towards listing (FSS); and/or
May affect individuals, but is not likely to lead to a decreasing population trend (MIS)
MALT - May affect individuals, and is likely to result in a trend towards listing (FSS); and/or
May affect individuals, and is likely to lead to a decreasing population trend (MIS)

There will be no long-term change in the baseline functionality of analysis Indicators. While there may be an insignificant benefit for Substrate/Sediment, Drainage Network, and Riparian Reserves under either Alternative, it will not be sufficient to change the existing condition.

Comparison of effects of alternatives for analysis Indicators:

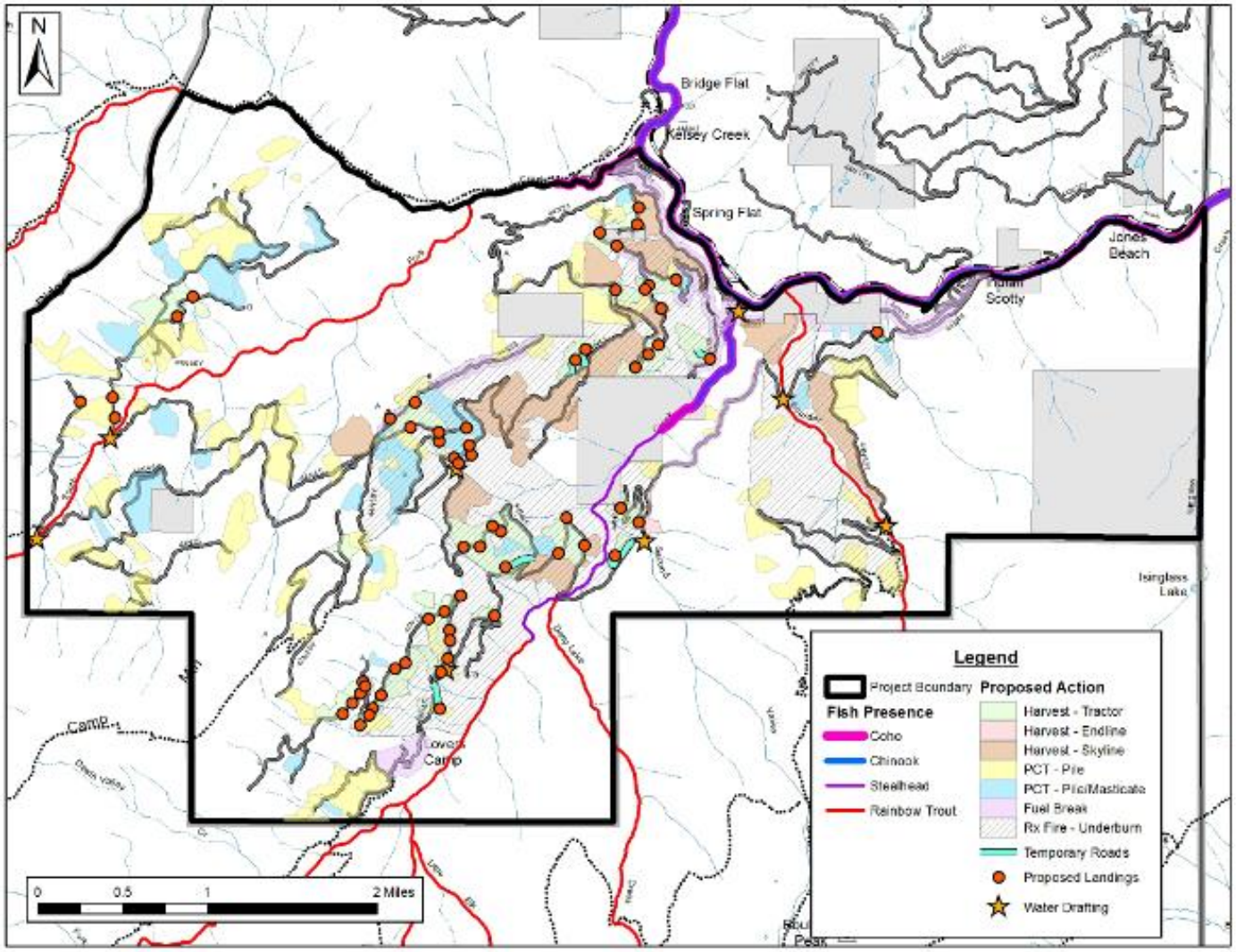
Indicator	Alternative 1 (no action)	Alternative 2	Alternative 3
Temperature	0	-/0	-/0
Substrate/Sediment	0	-/+	-/+
Turbidity	0	-/0	-/0
Large Woody Debris	0	-/0	-/0
Disturbance History/Regime	0	-/0	-/0
Peak/Base Flow	0	-/0	-/0
Drainage Network	0/-	-/+	-/+
Riparian Reserves	0	-/+	-/+

0 = Neutral effects
- = Insignificant or discountable negative effects
+ = Insignificant or discountable positive effects
S-= Significant negative effects
S+ = Significant positive effects
/ = Short-term/long-term effects

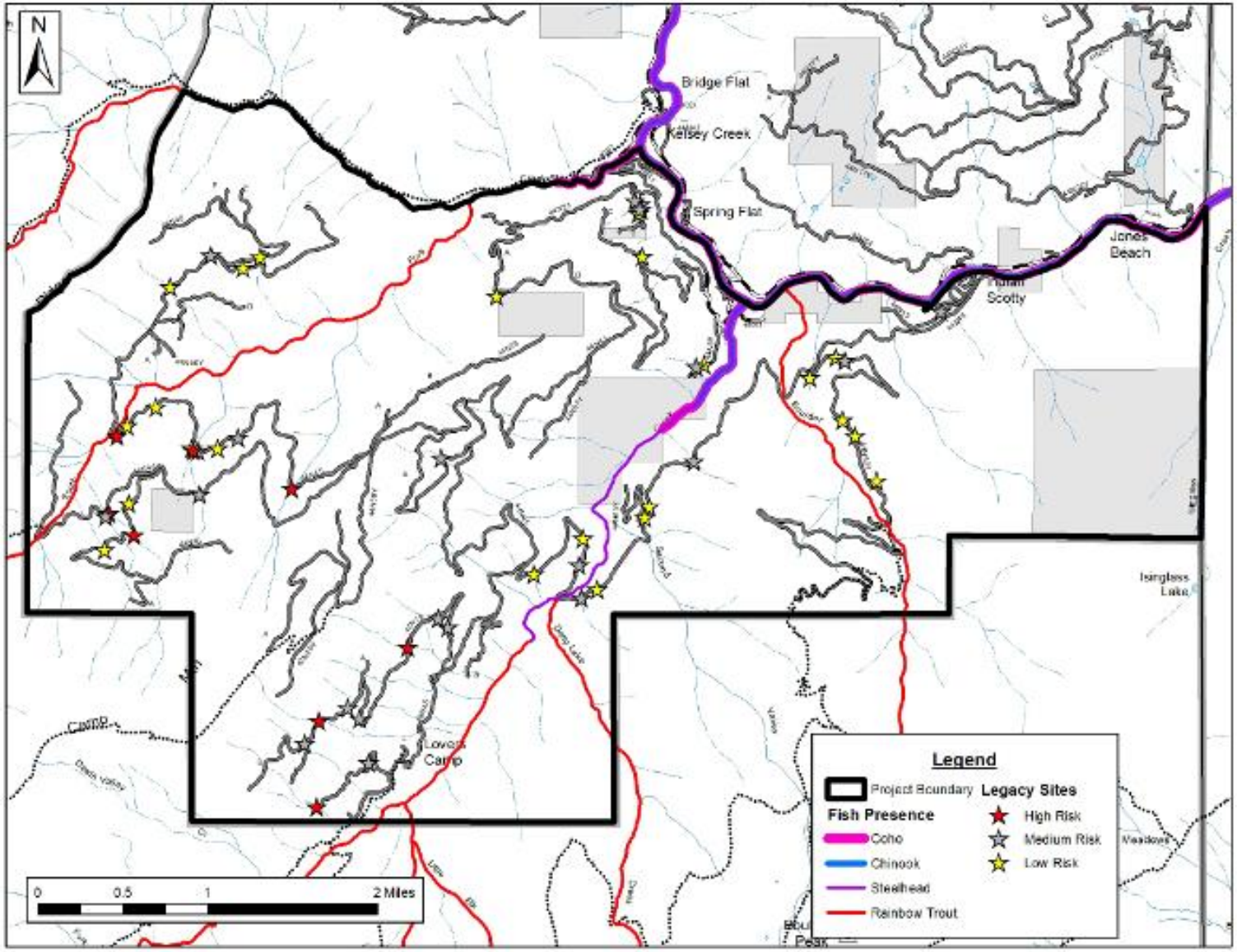
Compliance with law, regulation, policy, and the Forest Plan

All Alternatives will meet Forest Plan Standards and Guides, Endangered Species Act, Magnuson-Stevens Fishery Conservation and Management Act, Northwest Forest Plan, and all other relevant regulations, laws, and policies. The appropriate level of Section 7 consultation will be completed with the National Marine Fisheries Service.

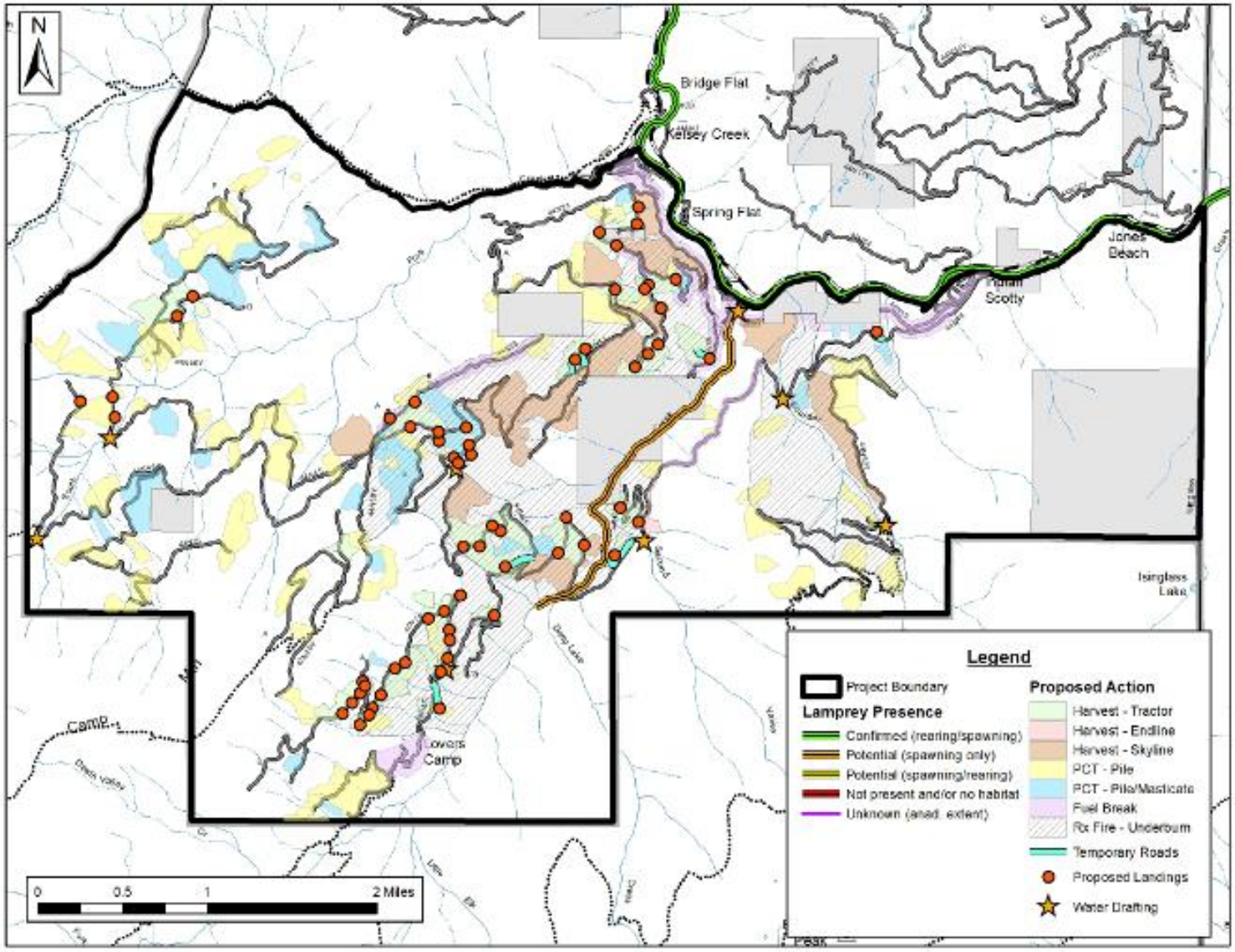
Maps and Figures



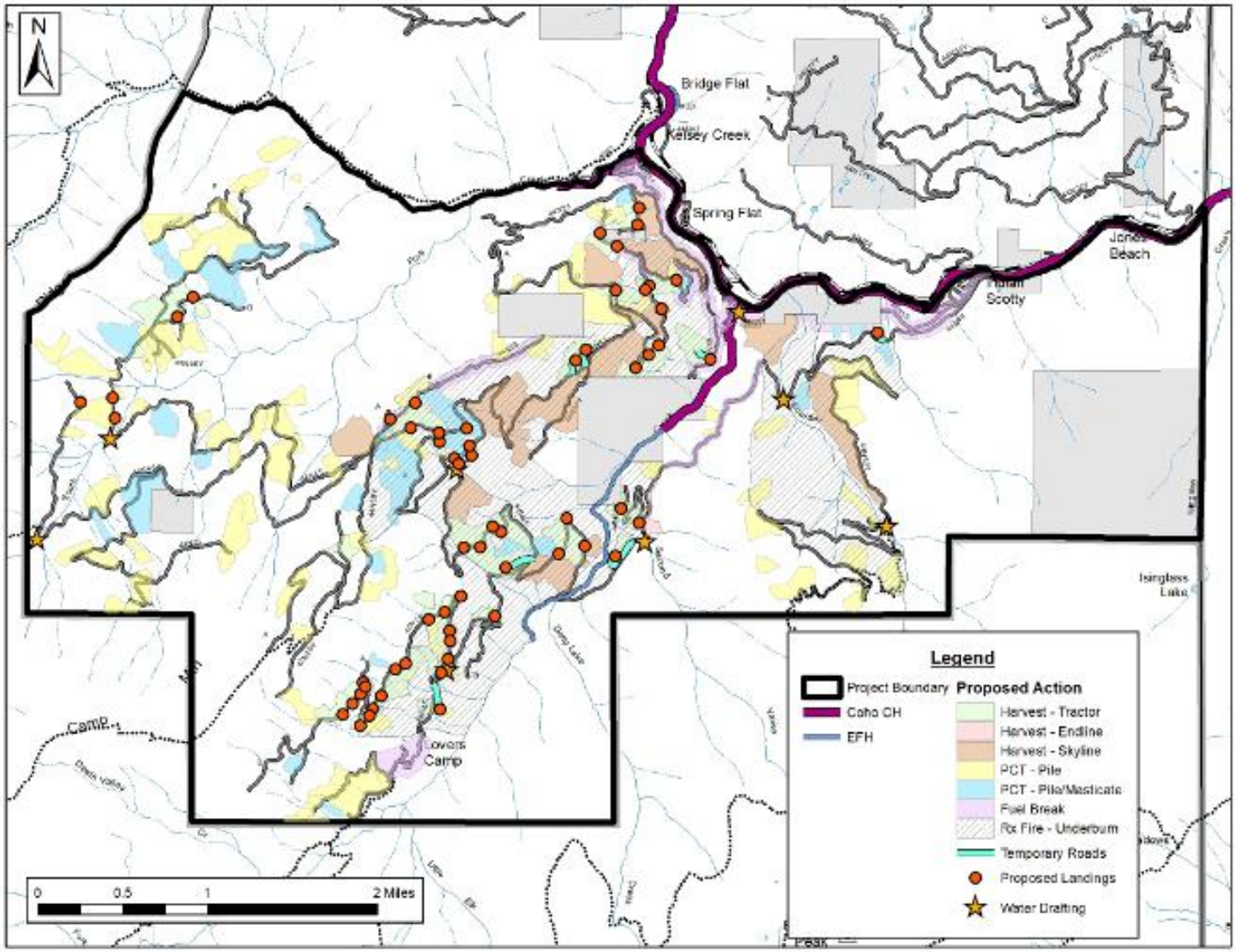
Map 1. Aquatic resources (salmonids) present within and nearby the Lover's Canyon Project. Includes all proposed Project elements except legacy site treatments.



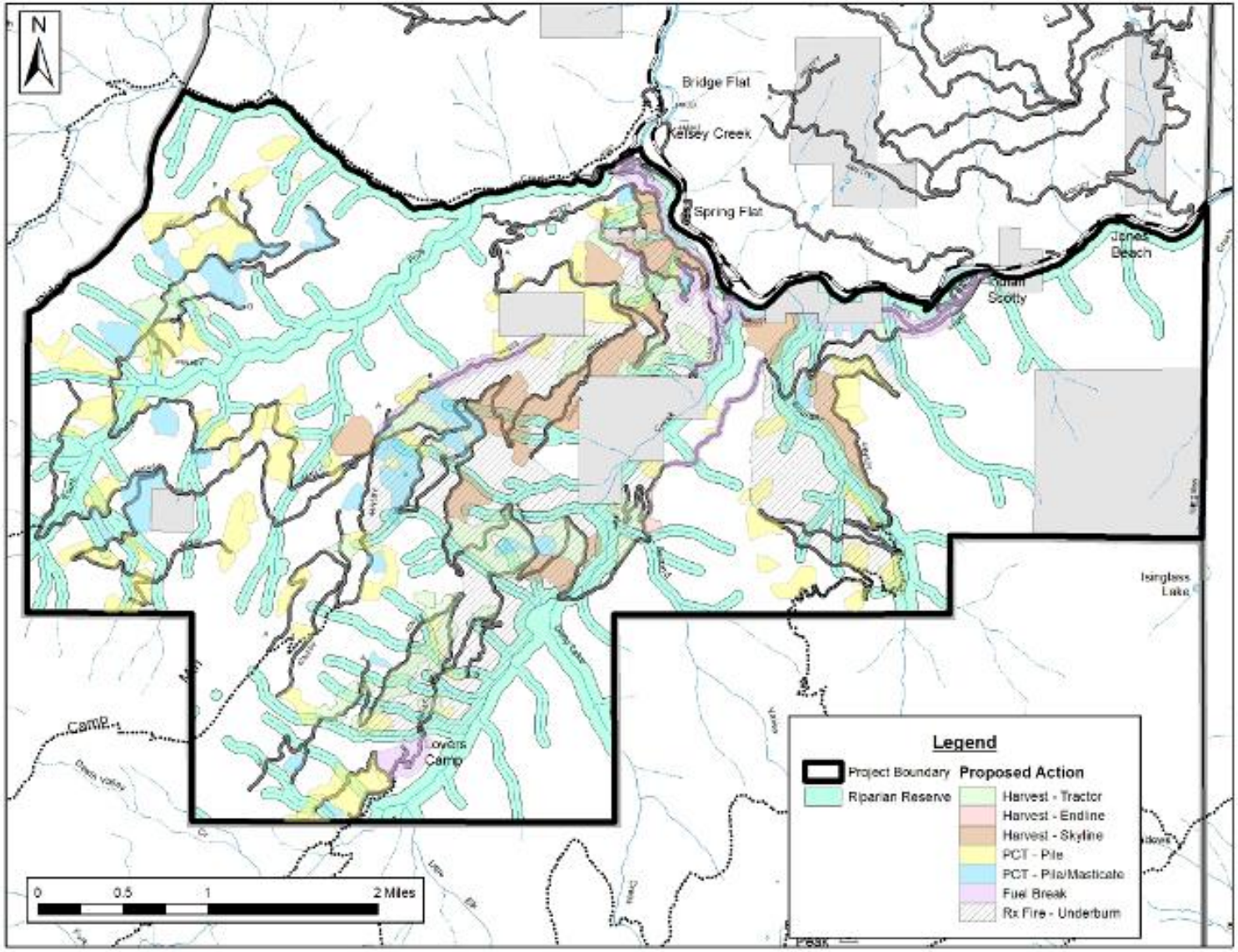
Map 2. Aquatic resources (salmonids) present within and nearby the Lover's Canyon Project. Includes legacy site treatments only.



Map 3. Aquatic resources (non-salmonid) present within and nearby Lover's Canyon Project. Includes all proposed Project elements except legacy site treatments.

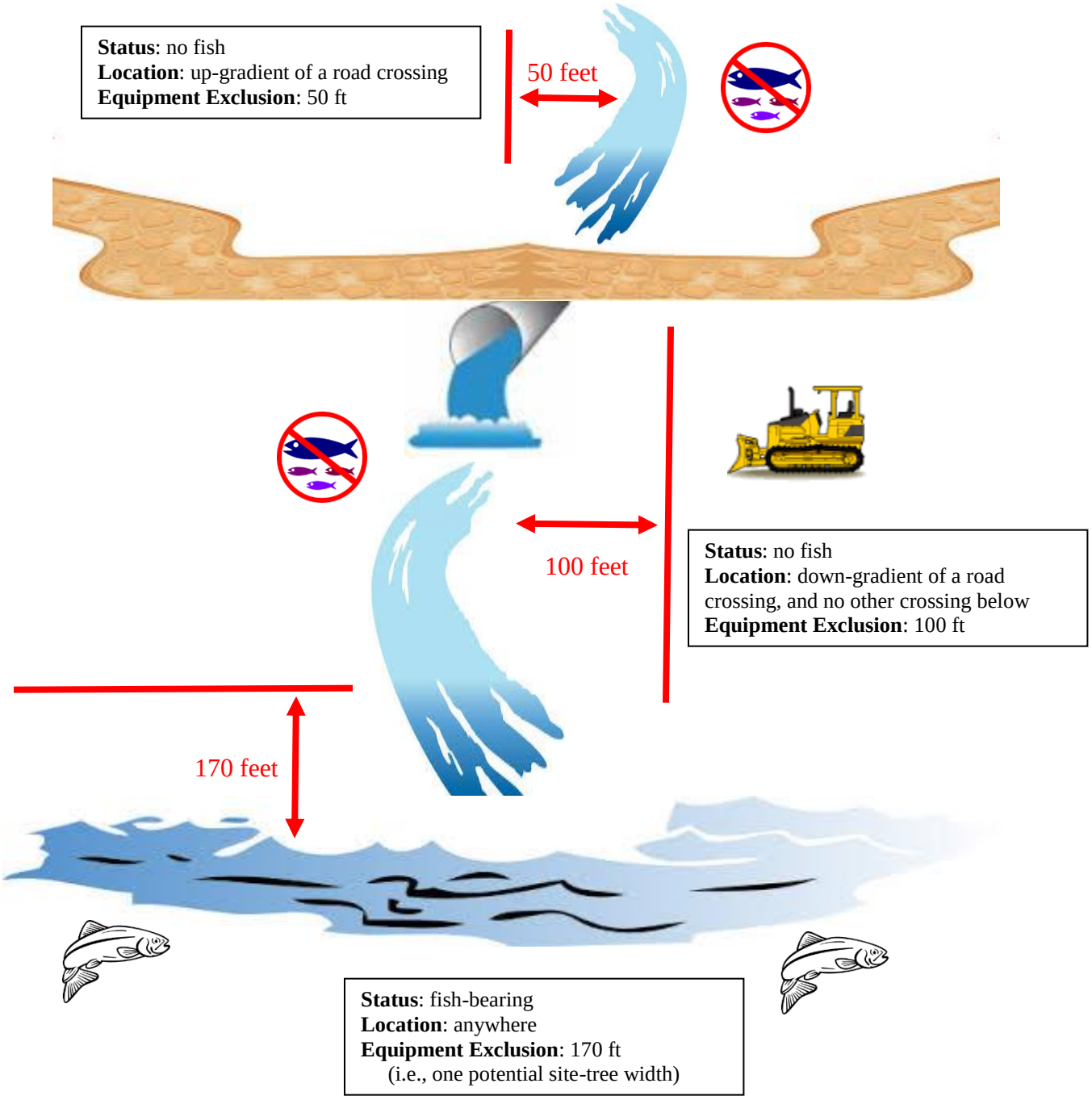


Map 4. Critical Habitat and Essential Fish Habitat for the Lover's Canyon Project. Includes all proposed Project elements except legacy site treatments.



Map 5. Project area with treatment units and hydrologic Riparian Reserves.

Figure 1. Equipment exclusion zone and no-treatment buffers in relation to aquatics systems.



Note

- Commercial treatments within plantations may occur as close as 15 ft to a stream. However, equipment must still abide by the relevant exclusion zone. Portions of equipment, such as masticator arms, may reach into exclusion zones to perform silviculture treatments, but the wheeled/tracked part of the body must remain outside.
- Commercial treatments in natural stands and/or adjacent to fish-occupied streams are congruent with equipment exclusion buffers.

Appendix A: Aquatic and Riparian Focus

A detailed Project description is found the Environmental Assessment and associated records. This appendix provides a focused summary of units and activities discussed in the text which occur within the Riparian Reserve and have the greatest potential to affect aquatic resources.

Table A-1. Commercial resource project measures for units with hydrologic Riparian Reserve inclusions – equipment exclusion distance, no-treatment buffer distance, and treatment notes. Also includes summary of pre-commercial thin which include mastication.

Unit #	Treatment Type	RR Size[1]	Equip Exclusion Dist (ft)	No Treatment Buffer Dist (ft)	Plantation Unit	Treatment Notes
Unit 524-054	Skyline	7.2	170' - Boulder Ck 50' - spring	Same as equip. exclusion distance		Upon field review, closest flagged edge of unit to creek was ~150'; and nearest marked trees was ~40' upslope from boundary. Therefore, treatment was confirmed to be outside of 170'.
Unit 524-055	Skyline	14.5	170' - Boulder Ck	Same as equip. exclusion distance		Upon field review, closest flagged edge of unit to creek was ~140-150'; and several marked trees were at ~150'. Less than 10 trees were observed closer than 170' from the creek in area of nearest boundary approach to water. Although these trees are within the no treatment buffer (equipment will still be outside), harvest will be allowed - shade will be maintained, other trees will remain, and it is only one location with a minimal number of trees under consideration.
Unit 526-008	Tractor	1.9	50' - all streams	15' - all streams	X	
Unit 526-010a	Tractor	1.7	170' - Canyon Creek 100' - perennial	Same as equip. exclusion distance	X	Additionally, exclusion zones are set 25' back from the break in slope to Second Valley Ck.
Unit 526-013	Tractor	1.1	50' - all streams	Same as equip. exclusion distance		Legacy site located within the unit will be treated.

Unit #	Treatment Type	RR Size[1]	Equip Exclusion Dist (ft)	No Treatment Buffer Dist (ft)	Plantation Unit	Treatment Notes
Unit 526-019	Tractor	1.5	50' - all streams (above road) 100' - all streams (below road)	15' - all streams	X	
Unit 526-020	Tractor	6.0	50' - all streams	15' - all streams	X	
Unit 526-030	Tractor	9.2	50' - all streams	15' - all streams	X	
Unit 526-031a	Tractor	7.3	50' - all streams	15' - all streams	X	
Unit 526-031b	Tractor	0.2	50' - all streams	15' - all streams	X	
Unit 526-064	Skyline	9.1	50' - all streams	Same as equip. exclusion distance		
Unit 526-073	Tractor	6.1	50' - all streams 50' - spring	Same as equip. exclusion distance		Intermittent channel mismapped: it does not bisect the unit, but instead follows the southern edge
Unit 526-076	Tractor	4.1	50' - all streams	Same as equip. exclusion distance		Additionally, exclusion zones are set 25' back from the break in slope to the creek.
Unit 526-080	Tractor	0.3	50' - pond	Same as equip. exclusion distance		
Unit 526-085	Skyline	6.2	50' - all streams	Same as equip. exclusion distance		
Unit 526-086	Skyline	9.6	50' - all streams	Same as equip. exclusion distance		
Unit 526-089	Tractor	7.9	50' - all streams	Same as equip. exclusion distance		No treatment between two intermittent channels.
Unit 526-097	Skyline	2.0	None - see notes	Same as equip. exclusion distance		Intermittent channel mapped as originating from meadow is not present. Without a stream, there is no RR; and, furthermore, no associated equip/treatment avoidance area is needed.

Unit #	Treatment Type	RR Size[1]	Equip Exclusion Dist (ft)	No Treatment Buffer Dist (ft)	Plantation Unit	Treatment Notes
Unit 526-098a	Tractor	15.2	50' - all streams	Same as equip. exclusion distance		More aggressive tree removal adjacent to meadow to enhance meadow character. Intermittent channel mapped as originating from meadow is not present. Without a stream, there is no RR; and, furthermore, no associated equip/treatment avoidance area is needed.
Unit 526-098b	Skyline	7.3	50' - all streams (above road) 100' - all streams (below road)	Same as equip. exclusion distance		Legacy site within the unit will be avoided.
Unit 526-103	Skyline	0.3	50' - all streams	Same as equip. exclusion distance		
Unit 526-104	Tractor	0.8	50' - all streams	Same as equip. exclusion distance		
Unit 526-109	Skyline	12.5	50' - all streams	Same as equip. exclusion distance		
Unit 526-110	Skyline	5.0	Road - Canyon Ck None - intermittent (see notes)	Same as equip. exclusion distance		Major access road separates stream from unit. RR within unit is not functioning as riparian due to topographic configuration and disconnect by road. Intermittent channel mapped as originating from meadow is not present. Without a stream, there is no RR; and, furthermore, no associated equip/treatment avoidance area is needed.
Unit 526-111	Skyline	3.0	170' - Canyon Creek	Same as equip. exclusion distance		
Unit 526-146	Tractor	1.4	170' - Canyon Creek 100' - perennial	Same as equip. exclusion distance		
Unit 526-197	Endline	1.3	50' - all streams	Same as equip. exclusion distance		

Unit #	Treatment Type	RR Size[1]	Equip Exclusion Dist (ft)	No Treatment Buffer Dist (ft)	Plantation Unit	Treatment Notes
Unit 527-012	Tractor	5.8	50' - all streams (above road) 100' - all streams (below road)	15' - all streams	X	
Unit 527-081	Tractor	0.7	50' - all streams	Same as equip. exclusion distance		
Unit 527-082	Tractor	0.1	100' - all streams	Same as equip. exclusion distance		
Unit 527-150	Skyline	1.3	100' - all streams	Same as equip. exclusion distance		
Mastication	PCT	20.8	170' - fish-bearing streams 100' - fishless streams - no culvert between activity and fish-bearing stream 50' - fishless streams - above roads	None - see analysis	X	Masticators may reach with arm into equip. exclusion zone to masticate trees. Trees out of reach of arm will be hand-cut. Hand-cut material may be piled/burned, else transported to masticator for disposal. 11 of 32 units include RR within the unit boundary.

[1]Hydrologic Riparian Reserves (RR) widths estimated by GIS buffering are calculated as if the terrain was flat. Because RR widths are measured as slope distances, GIS areas overestimate the acreage within RR when local terrain includes extensive gorges. In some locations, Project units may therefore be outside the RR. Furthermore, several units have mismapped stream channels – because these channels are either not present or located elsewhere, the associated RR designation may not apply or be mapped differently. In summary, many units include much less RR than suggested by this table.

Appendix B: Life History and Biological Requirements of Pacific Salmonids and Lamprey

Coho Salmon

General life history information and biological requirements of Southern Oregon/Northern California Coastal (SONCC) Coho salmon have been described in various documents (Hassler 1987; Sandercock 1991; Weitkamp, *et al*. 1995) as well as NOAA-Fisheries' final rule listing SONCC Coho salmon (May 6, 1997; 62 FR 24588) and the subsequent Recovery Plan (NOAA 2014).

Coho salmon enter the mainstem of the Klamath River for spawning typically in their third year, primarily between September and December, with a peak in October (NFMS 2007). Over most of this interval, mainstem flows below Iron Gate Dam often are high (ca. 2500-3000 cfs: NMFS 2001). Thus, standard methods for observing and counting spawning fish are not easily applied, and the size of the spawning population is unknown. Approximations put the entire ESU at about 10,000 spawning Coho salmon of non-hatchery origin per year (Weitkamp, *et al*. 1995), of which only a small portion is associated with the Klamath Basin, where several important tributary runs have been reduced to a handful of individuals (NMFS 2001, 2007). Although a minor amount of spawning and growth may occur in the mainstem, the mainstem serves adults primarily as a migration route (NFMS 2007).

Spawning occurs from November to January (Hassler 1987) in the tributaries to the Klamath River, but occasionally as late as February or March (Weitkamp, *et al*. 1995). Coho salmon eggs incubate for 35-50 days between November and March. Successful incubation depends on several factors including dissolved oxygen levels, temperature, substrate size, amount of fine sediment, and water velocity. Fry start emerging from the gravel two to three weeks after hatching and move into shallow areas with vegetative or other cover. As fry grow larger, they disperse up or downstream. In summer, Coho salmon fry prefer pools or other slower velocity areas such as alcoves, with woody debris or overhanging vegetation. Juvenile Coho salmon over-winter in slow water habitat with cover as well. Juveniles may rear in fresh water for up to 15 months then migrate to the ocean as smolts from March to June (Weitkamp, *et al.* 1995). Coho salmon adults typically spend two years in the ocean before returning to their natal streams to spawn as three-year olds.

Available historical and most recent published Coho salmon abundance information are summarized in the NOAA-Fisheries coast-wide status review (Weitkamp, *et al*. 1995). The rivers and tributaries in the California portion of this ESU were estimated to have average recent runs of 7,080 natural spawners and 17,156 hatchery returns, with 4,480 identified as native fish occurring in tributaries having little history of supplementation with non-native fish. However, limited information exists regarding Coho salmon abundance in the Klamath River basin. What information exists [NOAA 2014; CDFW unpub. data; U.S. Fish and Wildlife Service (USFWS) unpub. data] suggests adult populations are small to nonexistent in most years. The decline of SONCC Coho salmon across the ESU is not the result of one single factor, but rather a number of natural and anthropogenic factors that include dam construction, instream flow alterations; land use activities coupled with large flood events, fish harvest and hatchery effects.

Boulder Creek – Coho Surveys

Coho are not present in Boulder Creek. Spawning surveys were conducted in the winters of 2001/2, 2002/3, and 2004/5, but nothing was observed (NCRC 2002, 2003; RCD 2005). Boulder Creek stream is not considered to be accessible to anadromous fish because of barriers and steep gradient at the mouth preventing adult and juvenile Coho from occupying it. However, the confluence discharge area with Scott River is a known thermal refugia for Coho juveniles during periods of elevated water temperature in the mainstem Scott River (USFS 2005). A comprehensive review of datasets originating from multiple agencies/entities was conducted by CDFW, with the conclusion that Coho presence in Boulder Creek was not substantiated (Garwood 2012).

*CalFish query performed on 11/30/2015

- No live/dead fish nor redd counts available
- Coho distribution maps do not include Boulder Creek

Garwood, J. 2012. Historic and recent occurrence of Coho salmon (*Oncorhynchus kisutch*) in California streams within the Southern Oregon/Northern California Evolutionarily Significant Unit. Fisheries Branch Administrative Report, 2012-03. California Department Fish and Wildlife, Arcata, CA. 77 p.

Northern California Resource Center (NCRC). 2003. Scott River watershed adult Coho salmon spawning survey: December 2002 – January 2003. Report prepared by Northern California Resource Center for Siskiyou Resource Conservation Service (Etna, CA) and California Department of Fish and Game (Yreka, CA). 48 p + appendices.

Northern California Resource Center (NCRC). 2002. Scott River watershed adult Coho salmon spawning survey: December 2001 – January 2002. Report prepared by Northern California Resource Center for Klamath National Forest, Scott River, Fort Jones, CA. 30 p + appendices.

Siskiyou Resource Conservation District (RCD). 2005. Scott River watershed adult Coho spawning ground surveys: November 2004 – January 2005. Report prepared by Siskiyou Resource Conservation District for U.S. Fish and Wildlife Service (Yreka, CA) [Agreement #113333J027] and California Department of Fish and Game (Yreka, CA) [Agreement #P0310331]. 42 p + appendices.

U.S. Forest Service (USFS). 2005. Thermal refugia pilot study, Scott River Canyon, 2005. Klamath National Forest, Salmon-Scott River Ranger District, Fort Jones, CA. 31 p.

Canyon Creek – Coho Surveys

Coho are present in Canyon Creek. Spawning surveys have been conducted as early as the late-1980s; and most years starting winter 2001/2, with Coho redds, live fish, and/or carcasses observed occasionally (NCRC 2002, 2003; RCD 2005, 2011, 2013; M. Knechtle, pers. comm.; unpub. data). Snorkel surveys, which have been conducted by the Forest Service in Canyon Creek multiple times in conjunction with habitat assessment and other projects, recorded juvenile Coho in 1999, 2002, and 2005 (USFS 2006; unpub. data). Juvenile Coho were also seen in 2014 during monitoring following relocation of fish to Canyon Creek from drying areas in the Scott

Valley, but it is unclear how many of the fish seen originated as transplants and how many were natal or local non-natal (USFS 2014). Other surveys – snorkel, electrofishing – performed in 1992, 1993, 1994, 1997, and 1998 did not find Coho. The distribution of Coho in Canyon Creek is considered to end about 1.1 miles upstream the mouth due to gradient and multiple boulder/bedrock barriers (USFS 2006). The confluence discharge area with Scott River is a known thermal refugia for Coho juveniles during periods of elevated water temperature in the mainstem Scott River (USFS 2005). Finally, a comprehensive review of datasets originating from multiple agencies/entities was conducted by CDFW, with the conclusion that Coho presence in Canyon Creek was substantiated (Garwood 2012).

*CalFish query performed on 11/30/2015

- No live/dead fish counts available
- Coho distribution maps include Canyon Creek

Redd Count

- CalFish records available (1): 91193
  - Inclusive years (all datasets): 2002-2012
- Summary: Redds recorded 2004, 2007, 2010, 2011

Unpublished data and/or field notes from: 1988-1990, 1992-1994, 1997-1999, 2002

Personal communication: Morgan Knechtle, Fish Biologist, California Department of Fish and Wildlife (Yreka Field Office)

Garwood, J. 2012. Historic and recent occurrence of Coho salmon (*Oncorhynchus kisutch*) in California streams within the Southern Oregon/Northern California Evolutionarily Significant Unit. Fisheries Branch Administrative Report, 2012-03. California Department Fish and Wildlife, Arcata, CA. 77 p.

Northern California Resource Center (NCRC). 2003. Scott River watershed adult Coho salmon spawning survey: December 2002 – January 2003. Report prepared by Northern California Resource Center for Siskiyou Resource Conservation Service (Etna, CA) and California Department of Fish and Game (Yreka, CA). 48 p + appendices.

_____. 2002. Scott River watershed adult Coho salmon spawning survey: December 2001 – January 2002. Report prepared by Northern California Resource Center for Klamath National Forest, Scott River, Fort Jones, CA. 30 p + appendices.

Siskiyou Resource Conservation District (RCD). 2013. Scott River adult Coho spawning ground surveys: 2012-2013 season. Report prepared by Siskiyou Resource Conservation District for NOAA-National Marine Fisheries Service [Grant #NA08NMF4630659] and Task 2-Scott River Water Trust [Agreement #WE-133F-12SE-2377]. 32 p.

_____. 2011. Scott River adult Coho spawning ground surveys: 2010-2011 season. Report prepared by Siskiyou Resource Conservation District for U.S. Fish and Wildlife Service [Agreement #813339G030]. 26 p.

_____. 2005. Scott River watershed adult Coho spawning ground surveys: November 2004 – January 2005. Report prepared by Siskiyou Resource Conservation District for U.S. Fish and Wildlife Service (Yreka, CA) [Agreement #113333J027] and California Department of Fish and Game (Yreka, CA) [Agreement #P0310331]. 42 p + appendices.

U.S. Forest Service. 2014. 2014 juvenile Coho relocation assessment and monitoring. Salmon-Scott Ranger District, Klamath National Forest, Fort Jones, CA. 3 p + data.

_____. 2006. Habitat utilization by juvenile Coho salmon in selected tributaries of the Scott River, 2005. Report prepared by Northern California Resource Center for Klamath National Forest, Scott River, Fort Jones, CA. 31 p + appendices.

_____. 2005. Thermal refugia pilot study, Scott River Canyon, 2005. Klamath National Forest, Salmon-Scott River Ranger District, Fort Jones, CA. 31 p.

Kelsey Creek – Coho Surveys

Coho are present in Kelsey Creek. Spawning surveys have been conducted most years starting winter 2001/2, with Coho redds, live fish, and/or carcasses regularly observed in the mainstem or spawning channel (NCRC 2002, 2003; RCD 2005, 2011, 2013; M. Knechtle, pers. comm.). Snorkel surveys conducted by the Forest Service or cooperators recorded juvenile Coho in 1999, 2002, 2004, 2005, and 2015 (USFS 2006, 2015; unpub. data). Juvenile Coho were also seen in 2014 during monitoring following relocation of fish to Kelsey Creek from drying areas in the Scott Valley, but it is unclear how many of the fish seen originated as transplants and how many were natal or local non-natal (USFS 2014). Other surveys – ocular, snorkel, electrofishing – performed in 1987, 1997, and 1998 did not find Coho. The confluence discharge area with Scott River is a known thermal refugia for Coho juveniles during periods of elevated water temperature in the mainstem Scott River (USFS 2005). Finally, a comprehensive review of datasets originating from multiple agencies/entities was conducted by CDFW, with the conclusion that Coho presence in Canyon Creek was substantiated (Garwood 2012).

The limit of anadromy in Kelsey Creek is a series of unnamed waterfalls located ~0.65 miles upstream from the mouth. A 1987 habitat survey notes the mouth to be a "salmon barrier", although no details are provided. Blasting of the mouth and the upper barrier waterfall appears to have been attempted in 1987. No follow-up monitoring was done, but the mouth alteration may have been successful to promote general Coho and Chinook access into Kelsey Creek. The upstream action did not alter the falls sufficiently to open anadromous fish passage.

Also of note, a spawning channel was constructed adjacent the mouth of Kelsey Creek in 1985. Success in regards to spawning and rearing Coho and Chinook salmon was debatable, and formal use of the facility was abandoned in the mid-1990s. Since then, minimal maintenance has occurred. Coho use the bays for spawning on an irregular basis, dependent on brood year strength and discharge from the channel. The channel is also used on occasion by the California Department of Fish and Wildlife to deposit juvenile fish rescued from Scott Valley. As of 2016, the Forest Service was beginning decommissioning of the spawning channel due to lack of maintenance funds and fishery need.

*CalFish query performed on 11/30/2015

- No live/dead fish counts available
- Coho distribution maps do include Kelsey Creek

Redd Count

- CalFish records available (1): 91408
    - Inclusive years (all datasets): 2002-2012
- Summary: Redds recorded 2002, 2004, 2006-2008, 2010, 2011

- Note: redds may have been found in mainstem and/or spawning channel

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Unpublished data and/or field notes from: 1987, 1997-1999, 2002, 2004

Personal communication: Morgan Knechtle, Fish Biologist, California Department of Fish and Wildlife (Yreka Field Office)

Garwood, J. 2012. Historic and recent occurrence of Coho salmon (*Oncorhynchus kisutch*) in California streams within the Southern Oregon/Northern California Evolutionarily Significant Unit. Fisheries Branch Administrative Report, 2012-03. California Department Fish and Wildlife, Arcata, CA. 77 p.

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_____. 2002. Scott River watershed adult Coho salmon spawning survey: December 2001 – January 2002. Report prepared by Northern California Resource Center for Klamath National Forest, Scott River, Fort Jones, CA. 30 p + appendices.

Siskiyou Resource Conservation District (RCD). 2013. Scott River adult Coho spawning ground surveys: 2012-2013 season. Report prepared by Siskiyou Resource Conservation District for NOAA-National Marine Fisheries Service [Grant #NA08NMF4630659] and Task 2-Scott River Water Trust [Agreement #WE-133F-12SE-2377]. 32 p.

_____. 2011. Scott River adult Coho spawning ground surveys: 2010-2011 season. Report prepared by Siskiyou Resource Conservation District for U.S. Fish and Wildlife Service [Agreement #813339G030]. 26 p.

_____. 2005. Scott River watershed adult Coho spawning ground surveys: November 2004 – January 2005. Report prepared by Siskiyou Resource Conservation District for U.S. Fish and Wildlife Service (Yreka, CA) [Agreement #113333J027] and California Department of Fish and Game (Yreka, CA) [Agreement #P0310331]. 42 p + appendices.

U.S. Forest Service (USFS). 2015. Kelsey Creek. Salmon-Scott Ranger District, Klamath National Forest, Fort Jones, CA. 15 p.

_____. 2014. 2014 juvenile Coho relocation assessment and monitoring. Salmon-Scott Ranger District, Klamath National Forest, Fort Jones, CA. 3 p + data.

_____. 2006. Habitat utilization by juvenile Coho salmon in selected tributaries of the Scott River, 2005. Report prepared by Northern California Resource Center for Klamath National Forest, Scott River, Fort Jones, CA. 31 p + appendices.

_____. 2005. Thermal refugia pilot study, Scott River Canyon, 2005. Klamath National Forest, Salmon-Scott River Ranger District, Fort Jones, CA. 31 p.

SF Kelsey Creek – Coho Surveys

No surveys targeting Coho have been completed in SF Kelsey Creek. This stream is above the upstream limit of anadromy in the Kelsey Creek drainage.

*CalFish query performed on 11/30/2015

- No live/dead fish nor redd counts available
- Coho distribution maps do not include SF Kelsey Creek

Scott River – Coho Surveys

Coho are present in the Scott River in the general project area, with a focus on the reach between Bridge Flat Campground and the upstream Forest Service boundary. Specifics concerning suitability of the river in this location for spawning is poorly known due to often hazardous discharge conditions which are present in winter. However, the rotary screw trap operated by the CDFW annually records downmigrating smolts in the spring (most recent report: Debrick and Stenhouse 2014); and the video weir upstream of Indian Scotty Campground captures at least part of the spawning run in the late-fall/early-winter (Knechtle and Chesney 2015). When mainstem summer water temperatures are elevated, juvenile Coho are observed to congregate within the thermal refugual areas of Boulder Creek, Canyon Creek, and Kelsey Creek (USFS 2005).

*Location restricted, where possible, to general Project area (Bridge Flat Campground to Forest Service boundary)
*CalFish query performed on 11/30/2015

- See project record for expanded datasets referred in summary
- Coho distribution maps include the Scott River in the Project area

Live/Dead Fish Count

- CalFish records available (1): 90359
  - Inclusive years (all datasets): 1992-1997
- Summary: Coho recorded 1993-1996
- Note: specific locations not provided, but often mouth to Fort Jones

Redd Count

- CalFish records available (1): 91419
  - Inclusive years (all datasets): 2002-2012
- Summary: Redds recorded 2008, 2009
- Note: specific locations not provided, but likely similar reaches as Fall Chinook spawning surveys; high flows may make comprehensive surveys difficult

Other – Weir Operations (near mouth)

- CalFish records available (2): 90418, 90419
  - Inclusive years (all datasets): 1983-1991
- Summary: Coho recorded all years

Debrick, A., and K., Stenhouse, S. 2014. Final report Shasta and Scott River juvenile salmonid outmigrant study, 2014. Report #P071307. California Department of Fish and Game, Northern Region, Yreka, CA. 89 p.

Knechtle, M., and D. Chesney. 2015. 2014 Scott River salmon studies final report. California Department Fish and Wildlife, Northern Region, Yreka, CA. 25 p.

U.S. Forest Service (USFS). 2005. Thermal refugia pilot study, Scott River Canyon, 2005. Klamath National Forest, Salmon-Scott River Ranger District, Fort Jones, CA. 31 p.

Chinook Salmon

The following information was excerpted or summarized from NMFS status review of Chinook salmon (Meyers, *et al.* 1998). Chinook salmon mature between 2 and 6+ years of age (Meyers, *et al.* 1998). Fall-run Chinook salmon enter freshwater at an advanced stage of maturity, move rapidly to their spawning areas on the mainstem or lower tributaries of the rivers, and spawn within a few days or weeks of freshwater entry (Healey 1991). Incubation temperature for eggs is 5.0 to 14.4°C, with below 13.0°C preferred for optimal development in most stocks (McCullough 1999). Emerging fry generally do not develop normally above 12.8°C (McCullough 1999). Post-emergent fry seek out shallow, nearshore areas with slow current and good cover, and begin feeding on small terrestrial and aquatic insects and aquatic crustaceans. Once feeding, the optimal growth range for juveniles is 10.0 to 15.6°C, with fingerlings preferring to hold at 12 to 14°C (McCullough 1999). In preparation for their entry into a saline environment, juvenile salmon undergo physiological transformations known as smoltification that adapt them for their transition to salt water. For Chinook salmon, the recommended maximum temperature to maintain migratory response and seaward adaptation is 12.0°C; and at temperatures greater than 13.0°C, some physiological processes of smolting may be delayed, and, in extreme cases, reversed (McCullough 1999). Chinook salmon spend between one and four years in the ocean before returning to their natal streams to spawn (Meyers, *et al*. 1998). Chinook salmon addressed in this document exhibit an ocean-type life history, and smolts out-migrate predominantly as subyearlings, generally during April through July. Chinook salmon spend between 2 and 5 years in the ocean (Healey 1991), before returning to freshwater to spawn. Some Chinook salmon return from the ocean to spawn one or more years before full-sized adults return.

The UKT ESU includes fall- and spring-run Chinook salmon in the Klamath and Trinity River Basin upstream of the confluence of the Klamath and Trinity rivers. Historically, spring-run Chinook salmon were probably the predominate run. This ESU still retains several distinct spring-run populations, albeit at much reduced abundance levels. Fish from this ESU exhibit an ocean-type life history; however genetically and physically, these fish are quite distinct from coastal and Central Valley Chinook salmon ESUs. Genetic analysis indicated that this ESU form a unique group that is quite distinctive compared to neighboring ESUs. The majority of spring- and fall-run fish emigrate to the marine environment primarily as subyearlings, but have a significant proportion of yearling smolts. Recoveries of coded wire tags indicate that both runs have a coastal distribution off the California and Oregon coasts. The 2016 fall-run Chinook salmon run into the Klamath River system, as compiled by CDFW, was estimated to be 19,948 fish (17,502 adult and 2,446 grilse). Of the 15,818 basin-wide natural spawners (i.e., not of hatchery origin), 1,058 were from the Salmon River and 1,515 from the Scott River. The Klamath River run in 2015 was projected to be below average compared to recent historical average (KRTT 2016).

Boulder Creek – Chinook Surveys

Chinook are not present in Boulder Creek. No surveys targeting Chinook have been completed. This stream is not considered to be accessible to anadromous fish because of barriers and steep gradient at the mouth preventing adult and juvenile Chinook from occupying this creek. However, the confluence discharge area with Scott River is a known thermal refugia for Chinook juveniles during periods of elevated water temperature in the mainstem Scott River (USFS 2005).

*CalFish query performed on 11/30/2015

- No live/dead fish nor redd counts available
- Chinook distribution maps do not include Boulder Creek

U.S. Forest Service (USFS). 2005. Thermal refugia pilot study, Scott River Canyon, 2005. Klamath National Forest, Salmon-Scott River Ranger District, Fort Jones, CA. 31 p.

Canyon Creek – Chinook Surveys

Chinook are present in Canyon Creek. Sporadic spawning surveys have been conducted by the Forest Service and/or cooperators since the mid-1980s, with a more regular effort started in 2010. Redds and/or spawners were observed in 1985 and 2014 (USFS 2015; unpub. data). Although many snorkel surveys to document juvenile fish have occurred in Canyon Creek, young Chinook have only been observed in 1993 and 1994 (unpub. data). Unsuccessful survey years include 1997, 1998, 1999, 2002, 2005, and 2014 (USFS 2016, 2006; unpub. data). Electrofishing was attempted in 1992 and 1997, but no Chinook recorded. The distribution of Chinook in Canyon Creek is similar to Coho, and is considered to end about 1.1 miles upstream the mouth due to gradient and multiple boulder/bedrock barriers (USFS 2006). The confluence discharge area with Scott River is a known thermal refugia for juvenile salmonids during periods of elevated water temperature in the mainstem Scott River; and while no Chinook juveniles were documented during survey efforts in 2005, there is no barrier for fish to be occupy the refugia if they are present in the adjacent river (USFS 2005).

*CalFish query performed on 11/30/2015

- No live/dead fish nor redd counts available
- Chinook distribution maps do not include Canyon Creek

Unpublished data and/or field notes from: 1985, 1986, 1992-1994, 1997, 1999, 2002, 2010, 2012-2014

U.S. Forest Service (USFS). 2015. 2014 Fall Chinook spawning ground survey – Salmon-Scott Rivers Ranger District. Prepared by M. Meneks for Klamath National Forest, Salmon-Scott Rivers Ranger District, Fort Jones, CA. 20 p + appendices.

_____. 2014. 2014 juvenile Coho relocation assessment and monitoring. Salmon-Scott Ranger District, Klamath National Forest, Fort Jones, CA. 3 p + data.

_____. 2006. Habitat utilization by juvenile Coho salmon in selected tributaries of the Scott River, 2005. Report prepared by Northern California Resource Center for Klamath National Forest, Scott River, Fort Jones, CA. 31 p + appendices.

_____. 2005. Thermal refugia pilot study, Scott River Canyon, 2005. Klamath National Forest, Salmon-Scott River Ranger District, Fort Jones, CA. 31 p.

Kelsey Creek – Chinook Surveys

Chinook are present in Kelsey Creek. Spawning surveys have been conducted on a regular annual schedule since 2010. Redds and/or spawners were observed in 1990, 2010, and 2014 (USFS 2011, 2015a; unpub. data). Snorkle surveys conducted by the Forest Service and/or cooperators recorded juvenile Chinook in 1999, 2004, 2005, and 2015 (USFS 2006, 2015b; unpub. data). Juvenile Chinook were also seen in 2014 during monitoring following relocation of fish to Kelsey Creek from drying areas in the Scott Valley, but it is unclear how many of the fish seen originated as transplants and how many were natal or local non-natal (USFS 2014). Other surveys – ocular, snorkel, electrofishing – performed in 1987, 1997, 1998, and 2002 did not find Chinook. The confluence discharge area with Scott River is a known thermal refugia for Chinook juveniles during periods of elevated water temperature in the mainstem Scott River (USFS 2005).

See Kelsey Creek Coho salmon for discussions about upstream limit of anadromy and the spawning channel.

*CalFish query performed on 11/30/2015

- No live/dead fish nor redd counts available
- Chinook distribution maps do not include Kelsey Creek

Unpublished data and/or field notes from: 1987, 1997-1999, 2002, 2004, 2010, 2012-2014

U.S. Forest Service (USFS). 2015a. 2014 Fall Chinook spawning ground survey – Salmon-Scott Rivers Ranger District. Prepared by M. Meneks for Klamath National Forest, Salmon-Scott Rivers Ranger District, Fort Jones, CA. 20 p + appendices.

_____. 2015b. Kelsey Creek. Salmon-Scott Ranger District, Klamath National Forest, Fort Jones, CA. 15 p.

_____. 2014. 2014 juvenile Coho relocation assessment and monitoring. Salmon-Scott Ranger District, Klamath National Forest, Fort Jones, CA. 3 p + data.

_____. 2011. 2010 Fall Chinook spawning ground survey – Salmon-Scott Rivers Ranger District. Prepared by M. Meneks for Klamath National Forest, Salmon-Scott Rivers Ranger District, Fort Jones, CA. 12 p + appendices.

_____. 2006. Habitat utilization by juvenile Coho salmon in selected tributaries of the Scott River, 2005. Report prepared by Northern California Resource Center for Klamath National Forest, Scott River, Fort Jones, CA. 31 p + appendices.

_____. 2005. Thermal refugia pilot study, Scott River Canyon, 2005. Klamath National Forest, Salmon-Scott River Ranger District, Fort Jones, CA. 31 p.

SF Kelsey Creek – Chinook Surveys

No surveys targeting Chinook have been completed in SF Kelsey Creek. This stream is above the upstream limit of anadromy in the Kelsey Creek drainage.

*CalFish query performed on 11/30/2015

- No live/dead fish nor redd counts available
- Chinook distribution maps do not include SF Kelsey Creek

Scott River – Chinook Surveys

Chinook are present in the Scott River in the general project area, with a focus on the reach between Bridge Flat Campground and the upstream Forest Service boundary. Although individual agencies may have been conducting fish and/or redd surveys upon the Scott River for decades, cooperative multi-entity fall Chinook spawning surveys have occurred annually since 1992 (most recent reports: USFS 2016 and Knechtle and Chesney 2015 [CDFW]). Additionally, the rotary screw trap operated by the CDFW annually records downmigrating smolts in the spring (Debrick and Stenhouse 2014); and the video weir upstream of Indian Scotty Campground captures the portion of the fall spawning run destined for the Scott River Valley and upper canyon area (Knechtle and Chesney 2015). Finally, dive investigations into the presence/absence of spring Chinook occurred 2007 through 2009, with one adult Chinook seen in 2008 within the deep pools of the Scott River adjacent the Project area (QVIR 2010). When mainstem summer water temperatures are elevated, juvenile Chinook are observed to congregate within the thermal refugual areas of Boulder Creek, Canyon Creek, and Kelsey Creek (USFS 2005).

*Location restricted, where possible, to general Project area (Bridge Flat Campground to Forest Service boundary)
*CalFish query performed on 11/30/2015

- See project record for expanded datasets referred in summary
- Chinook distribution maps include the Scott River in the Project area

Live/Dead Fish Count

- CalFish records available (1): 90361
  - Inclusive years (all datasets): 1983-1986, 1992-1997
- Summary: Chinook recorded all years
- Note: specific locations not provided, but often mouth to Fort Jones

Redd Count

- CalFish records available (2): 90716, 91006
  - Inclusive years (all datasets): 1964-1972, 1974-1978, 1988, 1989, 1991-1997
- Summary: Redds recorded all years
- Note: specific locations not provided, but often "entire mainstem"

Other – Weir Operations (near mouth)

- CalFish records available (2): 90406, 90407
  - Inclusive years (all datasets): 1983-1991
- Summary: Chinook recorded all years

Other – Population Estimates

- CalFish records available (2): 90673, 90700
  - Inclusive years (all datasets): 1968, 1978-2013
- Summary: Chinook recorded all years

Debrick, A., and K., Stenhouse, S. 2014. Final report Shasta and Scott River juvenile salmonid outmigrant study, 2014. Report #P071307. California Department of Fish and Game, Northern Region, Yreka, CA. 89 p.

Knechtle, M., and D. Chesney. 2015. 2014 Scott River salmon studies final report. California Department Fish and Wildlife, Northern Region, Yreka, CA. 25 p.

Quartz Valley Indian Reservation (QVIR). 2010. 2007-2009 summer steelhead, spring Chinook, and Pacific lamprey dive surveys, Scott River, CA. Quartz Valley Indian Reservation, CA. 16 p.

U.S. Forest Service (USFS). 2016. 2015 Fall Chinook spawning ground survey – Salmon-Scott Rivers Ranger District. Prepared by M. Meneks for Klamath National Forest, Salmon-Scott Rivers Ranger District, Fort Jones, CA. 23 p + appendices.

_____. 2005. Thermal refugia pilot study, Scott River Canyon, 2005. Klamath National Forest, Salmon-Scott River Ranger District, Fort Jones, CA. 31 p.

Steelhead

Biologically, steelhead can be divided into two basic run-types, based on the state of sexual maturity at the time of river entry and duration of spawning migration (Moyle 2002). The stream-maturing type, or summer steelhead, enters fresh water in a sexually immature condition and requires several months in freshwater to mature and spawn. The ocean-maturing type, or winter steelhead, enters fresh water with well-developed gonads and spawns shortly after river entry (August 9, 1996, 61 FR 41542; Barnhart 1986). South of Cape Blanco, Oregon, summer steelhead are known to occur in the Rogue, Smith, Klamath, Trinity, Mad, and Eel rivers, and in Redwood Creek (Busby, *et al.* 1996).

Winter steelhead in California enter fresh water after rivers rise in response to fall/winter rains, typically from December through March, with a peak in January and February, with spawning soon after reaching the breeding grounds (Moyle 2002). In contrast, summer steelhead enter systems as flows taper off in the spring, then spawn the following winter (Moyle 2002). Steelhead require a minimum depth of 0.18 m and a maximum velocity of 2.44 m/s for active upstream migration (Smith 1973). Spawning and initial rearing of juvenile steelhead generally take place in small, moderate-gradient (generally 3-5%) tributary streams (Nickelson, *et al*. 1992). A minimum depth of 0.18 m, water velocity of 0.30-0.91 m/s, and clean substrate 0.6-10.2 cm (Nickelson, *et al*. 1992) are required for spawning. Steelhead spawn in 3.9-9.4°C water (Bell 1991). Depending on water temperature, steelhead eggs may incubate for 1.5 to 4 months (August 9, 1996, 61 FR 41542) before hatching, generally between February and June (Bell 1991). After two to three weeks, in late spring, and following yolk sac absorption, alevins emerge from the gravel and begin actively feeding. After emerging from the gravel, fry usually inhabit shallow water along banks of perennial streams. Fry occupy stream margins (Nickelson, *et al*. 1992). Summer rearing takes place primarily in the faster parts of pools, although young-of-the-year are abundant in glides and riffles. Winter rearing occurs more uniformly at lower densities across a wide range of fast and slow habitat types. Productive steelhead habitat is characterized by complexity, primarily in the form of large and small wood. Some older juveniles move downstream to rear in larger tributaries and mainstem rivers (Nickelson, *et al*. 1992). Steelhead prefer water temperatures ranging from 12-15°C (Reeves *et al*. 1987). Juveniles live in freshwater from one to four years (usually two years in the California ESUs), then smolt and migrate to the ocean in March and April (Barnhart 1986). Winter steelhead populations generally smolt after two years in fresh water (Busby, *et al*. 1996).

The KMP steelhead ESU occurs in coastal river basins between the Elk River in Oregon and the Klamath River in California, inclusive. The KMP steelhead ESU contains populations of both winter and summer steelhead. The Rogue and Klamath River basins are distinctive in that they are two of the few basins producing "half-pounder" steelhead. In 2001, NOAA-Fisheries reconsidered the status of KMP steelhead under the ESA (66 FR 17845, April 4, 2001) and determined that KMP steelhead do not warrant listing as threatened or endangered at this time.

In California, the largest proportions of naturally spawning hatchery fish are believed to occur in the Trinity River, where estimates from 1990s range from 20-70 percent hatchery. These estimates apply to fall-run fish. Because the hatchery program in the Trinity River basin propagates mostly fall-run fish, natural spawners in this basin that return at other times are believed to be predominantly of natural origin. Counts at Willow Creek weir provide an estimate of about 2000 natural origin fall-run spawners per year. The Willow Creek weir samples steelhead only over a period of about 3 months during the fall run and thus provides no

information about other runs in the basin. CDFW biologists estimated natural escapement in the California portion of the ESU to be approximately 30,000-50,000 adults per year.

Rainbow Trout

Rainbow trout are native to Pacific slope drainages from the Kuskokwim River in Alaska to Baja California, Mexico (Moyle 2002). However their distribution has expanded significantly, including previously fishless streams and lakes, due to introductions. Rainbow trout is a Management Indicator Species (MIS) in on the Klamath National Forest.

Rainbow trout inhabit a wide variety of habitats. However, stream dwelling rainbows tend to prefer waters with a higher percentage of riffles than pools. Optimal habitat conditions include temperatures between 15 and 18^{o}C, slightly alkaline water (pH 7-8), and oxygen concentrations close to saturation. Temperatures above 28^{o}C are known to be lethal to rainbow trout; and for large fish, lethal temperatures may be around 23-25^{o}C. In summer, where water temperatures begin to approach the upper range of tolerance, trout will seek cooler microhabitats (Moyle 2002).

Adult forage and dispersal patterns appear to vary with local conditions, environmental factors, and the presence of other fish species (Meehan and Bjornn 1991, Moyle 2002). Rainbow trout are typically diurnal, opportunistic feeders. They are carnivores that feed in a rover-predator style. The majority of their diet consists of aquatic insects, although they will eat crayfish, grasshoppers, winged bugs, worms, salamanders, and other fish (including other trout). They occasionally feed on benthic invertebrates when the benthic food supply is great and/or when there is increased competition for prey form the water column (Behnke 2002).

Rainbow trout usually spawn between the ages of 2 to 4 years old. Age of first spawn can vary greatly depending on size and genetics (Behnke 2002). Female fecundity ranges from 1,200-3,200 eggs per kilogram of body weight (Behnke 2002). Rainbow trout spawning behavior typically begins during the spring but can begin as early as in December and varies due to temperature and water flow conditions. Temperatures of 3-6^{o}C often initiate spawning behavior, although actual spawning does not usually occur until temperatures reach 6-9^{o}C (Behnke 2002). In lakes, this often means moving from the lake into their natal stream. If the lake is not stream-fed, rainbow trout will move into near-shore shallow waters (Moyle and Cech 2000). In rivers, rainbow trout will migrate from feeding areas into smaller, cool-water tributaries (Moyle and Cech 2000). Both rainbow and steelhead trout are iteroparous, meaning that they can spawn more than once throughout their lifetime

Boulder Creek – Steelhead/Rainbow Trout Surveys

Steelhead are not present in Boulder Creek. No surveys targeting steelhead have been completed. This stream is not considered to be accessible to anadromous fish because of barriers and steep gradient at the mouth preventing adult and juvenile steelhead from occupying this creek. However, the confluence discharge area with Scott River is a known thermal refugia for steelhead/rainbow trout juveniles during periods of elevated water temperature in the mainstem Scott River (USFS 2005).

Resident rainbow trout are present in Boulder Creek. Few records concerning rainbow trout in Boulder Creek are available. Origination of fish – natural extent versus anthropogenic extent – is uncertain given historic planting (and current occupation) of fish in the headwater lake of Lower Wright Lake. Presently, rainbow trout are considered to fully occupy the 3.8 miles of stream between lake and the confluence with Scott River. A 1981 survey noted trout presence in the lower portion of the creek (unpub. data); and the District Fish Biologist has seen fish as least as high as the Forest Road 44N53Y crossing, which is located adjacent the Boulder Creek trailhead (pers. obs.).

*CalFish query performed on 11/30/2015

- No live/dead fish nor redd counts available
- Steelhead distribution maps do not include Boulder Creek

Unpublished data and/or field notes from: 1981

U.S. Forest Service (USFS). 2005. Thermal refugia pilot study, Scott River Canyon, 2005. Klamath National Forest, Salmon-Scott River Ranger District, Fort Jones, CA. 31 p.

Canyon Creek – Steelhead/Rainbow Trout Surveys

Both steelhead and resident rainbow trout are present in Canyon Creek. Canyon Creek was visited to check for steelhead spawning throughout the 1980s and into the early 1990s, with redds and/or fish being recorded all survey years – 1981, 1983-1992 (unpub. data). Except in the case of obvious barriers to anadromous fish, snorkel surveys generally do not make distinction between small resident trout and steelhead due to the impossibility to differentiate the two; and larger sizes are also rarely separated. Snorkel or electrofishing surveys conducted by Forest Service and/or cooperators in 1992-1994, 1997-1999, 2002, and 2005 reported steelhead/rainbow trout (USFS 2006; unpub. data). Juvenile steelhead/rainbow trout were also seen in 2014 during monitoring following relocation of fish to Canyon Creek from drying areas in the Scott Valley, but it is unclear how many of the fish seen originated as transplants and how many were natal or local non-natal (USFS 2014). Additionally, the confluence discharge area with Scott River is a known thermal refugia for steelhead/rainbow trout juveniles during periods of elevated water temperature in the mainstem Scott River (USFS 2005).

Steelhead distribution in Canyon Creek extends further upstream the system compared to Coho and Chinook (see respective discussions). Anadromy is official considered to end ~2.5 miles upstream from the mouth at a bedrock falls located upcanyon of the Forest Road 44N45 bridge crossing. However, boulder/bedrock barriers and steep gradient present above Second Valley

Creek (~1.8 miles from mouth) suggest occupation upstream of this point limited to questionable.

Resident rainbow trout only occupy Canyon Creek upstream of steelhead barriers into the extreme headwaters, including the mainstem and primary subdrainages (Deep Lake Creek, Little Elk Lake Creek, Red Rock Creek). Due to focus on the anadromous portion of Canyon Creek, fish surveys higher in the drainage for rainbow trout are limited. Ocular surveys noting resident rainbow trout presence are available for 1970 and 1981, and snorkel surveys for 1993 (CDFW 1970; unpub. data).

*CalFish query performed on 11/30/2015

- No live/dead fish nor redd counts available
- Steelhead distribution maps do include Canyon Creek

Unpublished data and/or field notes from: 1981, 1983-1994, 1997-1999, 2002

California Department of Fish and Wildlife (CDFW). 1970. Canyon Creek, tributary to Scott River. California Department of Fish and Game [Wildlife], Yreka, CA. 2 p.

U.S. Forest Service (USFS). 2014. 2014 juvenile Coho relocation assessment and monitoring. Salmon-Scott Ranger District, Klamath National Forest, Fort Jones, CA. 3 p + data.

_____. 2006. Habitat utilization by juvenile Coho salmon in selected tributaries of the Scott River, 2005. Report prepared by Northern California Resource Center for Klamath National Forest, Scott River, Fort Jones, CA. 31 p + appendices.

_____. 2005. Thermal refugia pilot study, Scott River Canyon, 2005. Klamath National Forest, Salmon-Scott River Ranger District, Fort Jones, CA. 31 p.

Kelsey Creek – Steelhead/Rainbow Trout Surveys

Both steelhead and resident rainbow trout are present in Kelsey Creek. Kelsey Creek was visited to check for steelhead spawning throughout the 1980s and into the early 1990s, with redds and/or fish being recorded all survey years – 1981, 1983-1986, 1988-1992 (unpub. data). More recent spawning surveys have been very intermittent, but both years with data available – 2002, 2013 – had positive redd sightings (unpub. data). Except in the case of obvious barriers to anadromous fish, snorkel surveys generally do not make distinction between small resident trout and steelhead due to the impossibility to differentiate the two; and larger sizes are also rarely separated. Snorkel, electrofishing, or ocular surveys conducted by Forest Service and/or cooperators in 1970, 1978, 1987, 1989, 1997-1999, 2002, 2005, and 2015 all reported steelhead/rainbow trout (CDFW 1970; USFS 2006, 2015; unpub. data). Juvenile steelhead/rainbow trout were also seen in 2014 during monitoring following relocation of fish to Kelsey Creek from drying areas in the Scott Valley, but it is unclear how many of the fish seen originated as transplants and how many were natal or local non-natal (USFS 2014). Additionally, the confluence discharge area with Scott River is a known thermal refugia for steelhead/rainbow trout juveniles and summer steelhead adults during periods of elevated water temperature in the mainstem Scott River (USFS 2005).

See Kelsey Creek Coho salmon for discussions about upstream limit of anadromy and the spawning channel. Steelhead have been observed using the spawning channel.

Resident rainbow trout occupy Kelsey Creek upstream of the anadromous waterfall barrier into the extreme headwaters. Due to focus on the anadromous portion of Kelsey Creek, fish surveys higher in the drainage for rainbow trout are limited. Ocular surveys noting resident rainbow trout presence are available for 1970, 1978, 1987, and 1989 (CDFW 1970; unpub. data).

*CalFish query performed on 11/30/2015

- No live/dead fish nor redd counts available
- Steelhead distribution maps do include Kelsey Creek

Unpublished data and/or field notes from: 1978, 1981, 1983-1987, 1988-1992, 1997-1999, 2002, 2013

California Department of Fish and Wildlife (CDFW). 1970. Kelsey Creek. California Department of Fish and Game [Wildlife], Yreka, CA. 1 p.

U.S. Forest Service (USFS). 2015. Kelsey Creek. Salmon-Scott Ranger District, Klamath National Forest, Fort Jones, CA. 15 p.

_____. 2014. 2014 juvenile Coho relocation assessment and monitoring. Salmon-Scott Ranger District, Klamath National Forest, Fort Jones, CA. 3 p + data.

_____. 2006. Habitat utilization by juvenile Coho salmon in selected tributaries of the Scott River, 2005. Report prepared by Northern California Resource Center for Klamath National Forest, Scott River, Fort Jones, CA. 31 p + appendices.

_____. 2005. Thermal refugia pilot study, Scott River Canyon, 2005. Klamath National Forest, Salmon-Scott River Ranger District, Fort Jones, CA. 31 p.

SF Kelsey Creek – Steelhead/Rainbow Trout Surveys

Resident rainbow trout are present in SF Kelsey Creek. As this tributary to Kelsey Creek is located upstream of the mainstem anadromous barrier, the only salmonid which is recognized to occupy the stream is rainbow trout. Fish occupy about 4.1 miles of stream, with upstream extent limited by gradient and natural barriers. Limited records concerning rainbow trout in SF Kelsey Creek are available. Ocular and snorkel records exist for 1970, 1971, 1978, and 1989 (CDFW 1970; unpub. data); and the District Fish Biologist has observed fish upstream of the Forest Road 44N44 crossing (pers. obs.).

Unpublished data and/or field notes from: 1971, 1978, 1989

California Department of Fish and Wildlife (CDFW). 1970. South Fork Kelsey Creek. California Department of Fish and Game [Wildlife], Yreka, CA. 1 p.

Scott River – Steelhead/Rainbow Trout Surveys

Steelhead and resident rainbow trout are present in the Scott River in the general project area, with a focus on the reach between Bridge Flat Campground and the upstream Forest Service boundary. Specifics concerning suitability of the river in this location for spawning is poorly known due to often hazardous discharge conditions which are present in spring. However, the

rotary screw trap operated by the CDFW annually records downmigrating smolts in the spring (Debrick and Stenhouse 2014); and the video weir upstream of Indian Scotty Campground regularly captures movement of fish in the fall and early winter (Knechtle and Chesney 2015). Finally, dive investigations into the presence/absence of summer steelhead occurred 2007 through 2009, with adults and/or half-pounders recorded each year within deep pools of the Scott River adjacent the Project (QVIR 2010). When mainstem summer water temperatures are elevated, juvenile steelhead/rainbow trout are observed to congregate within the thermal refugual areas of Boulder Creek, Canyon Creek, and Kelsey Creek (USFS 2005).

*Location restricted, where possible, to general Project area (Bridge Flat Campground to Forest Service boundary)
*CalFish query performed on 11/30/2015

- See project record for expanded datasets referred in summary
- No redd counts available
- Steelhead distribution maps include the Scott River in the Project area

Live/Dead Fish Count

- CalFish records available (2): 90360, 91034
    - Inclusive years (all datasets): 1992-1997
- Summary: Steelhead recorded in 1994, 1995, 1997
- Note: specific locations not provided, but often mouth to Fort Jones

Other – Weir Operations (near mouth)

- CalFish records available (2): 90420, 90421
    - Inclusive years (all datasets): 1982-1985, 1987, 1989- 1991
- Summary: Steelhead recorded all years

Debrick, A., and K., Stenhouse, S. 2014. Final report Shasta and Scott River juvenile salmonid outmigrant study, 2014. Report #P071307. California Department of Fish and Game, Northern Region, Yreka, CA. 89 p.

Knechtle, M., and D. Chesney. 2015. 2014 Scott River salmon studies final report. California Department Fish and Wildlife, Northern Region, Yreka, CA. 25 p.

Quartz Valley Indian Reservation (QVIR). 2010. 2007-2009 summer steelhead, spring Chinook, and Pacific lamprey dive surveys, Scott River, CA. Quartz Valley Indian Reservation, CA. 16 p.

U.S. Forest Service (USFS). 2005. Thermal refugia pilot study, Scott River Canyon, 2005. Klamath National Forest, Salmon-Scott River Ranger District, Fort Jones, CA. 31 p.

Critical Habitat for Coho Salmon (and) Essential Fish Habitat for Coho/Chinook Salmon

Designated Critical Habitat (CH) for Coho salmon encompasses accessible reaches of all rivers (including estuarine areas and tributaries) between the Mattole River in California and the Elk River in Oregon, inclusive (May 5, 1999, 64 FR 24049). The area described in the final rule represented the current freshwater and estuarine range of Coho salmon. Land ownership patterns within the Coho salmon ESU analyzed in this document and spanning southern Oregon and northern California are 53% private lands; 36% Federal lands; 10% State and local lands; and 1% Tribal lands. The Forest Service manages about 1,680,000 acres (90.6%) of land within the Forest boundaries and about 200,000 acres (9.4%) of land are within the Forest boundaries but in other ownership (LRMP, Page 3-12). Essential Fish Habitat (EFH) is considered for both Coho and Chinook salmon, with consultation occurring under 305 (b) (4) (A) of the Magnuson-Stevens Fishery Conservation and Management Act. The definition of Coho/Chinook EFH components and extent is described by Amendment 14 (Appendix A, pages 12-35 [adopted year 2000]) of the 1978 Pacific Fisheries Management Council Salmon Fisheries Management Plan.

Conclusions regarding CH and EFH occurrence are based on field review of habitat suitability, professional judgment, District fish survey records, and California Department of Fish and Wildlife (CDFW) information. In general, the KNF Coho Presence (GIS) layer defines CH, and Coho or Chinook distribution (whichever is of maximal extent) defines EFH. As appropriate, the California state information in Calfish.org may also be utilized. Where information on Coho or Chinook is lacking (e.g., no/few surveys have been completed), else it is the professional judgment of the Fish Biologist that neither KNF nor Calfish.org range maps fully capture CH/EFH extent, the KNF Steelhead Trout Distribution (GIS) layer may be used as a proxy for maximum range of anadromous fishes. This dataset is recognized as a conservative approach for assessment of effects to anadromous fish habitat because Coho and Chinook salmon may not occupy the same waters as steelhead due to differences in jumping abilities. The maximum jumping height (under ideal conditions) for Coho is 2.2 meters; Chinook salmon is 2.4 meters; and steelhead is 3.4 meters (Meehan 1991). Therefore, steelhead trout can access more habitat than Coho or Chinook salmon (i.e., steelhead trout can make a 3-meter jump to migrate up a stream, but Coho and Chinook salmon cannot.). Additionally, differences in spawn timing may also affect actual distribution. As an example, steelhead spawn in the spring, encountering higher discharge conditions than Chinook, which spawn in the fall. In consequence, Chinook may be denied access to streams, or segments thereof, due to the presence of low-water barriers that are passible to steelhead during spring flows.

In all cases, field review and site-specific surveys may refine the location of CH or EFH.

Map 4 shows the distribution of CH and EFH the Action Area and Analysis Area. This map is based on fish distribution with site-specific changes made per professional fisheries biologist knowledge, stream surveys, or CDFW data. Field review, survey history, and CalFish.org agree that Coho presence is appropriately reflected by the existing Forest Service map database for the Project area. Extensive fish surveys have occurred Canyon Creek and Kelsey Creek, defining Coho distribution and locating barriers to anadromy. Therefore, Coho distribution (and, thus, CH) will not follow steelhead distribution in the Project area, instead utilizing the Klamath National Forest and CalFish.org maps. Elsewhere in the Project area, barriers, such as those at the mouth of Boulder Creek, low stream discharge, and/or steep gradients lacking pool habitat control distribution of Coho and other anadromous fish, both adults and juveniles. Since the extent of Coho and Chinook within the Project boundary is known to be similar, Coho distribution will also define Project area EFH.

Lamprey

Pacific Lamprey (*Entosphenus tridentata*)

Pacific lamprey are found in north Pacific coast streams from Japan, through Alaska, and down the North America continent coast, potentially as far as southern California or Baja California (USFWS 2012; Moyle 2002). This species has many derivative forms, including anadromous (the most common), resident, and landlocked; and the relationship between *E. tridentata* and its multiple forms, as well as similar species, is not fully resolved (Moyle 2002). Pacific lamprey is a Sensitive species for the Klamath National Forest.

Pacific lamprey are usually anadromous, with two distinct parts of their complex life cycle. Following is a generalized life cycle description, as summarized from Moyle (2002), Close, *et al*. (2010), and USFWS (2012). After hatching in freshwater in the late spring and early summer, larvae (ammocoetes) leave the nest and passively drift until suitable substrate – sand/silt – is encountered. Once a site is colonized, the blind larvae filter feed upon detritus for an extended period of time. Length of in-stream residence is uncertain, an individual may retain a larval form between three to seven years, with four to six years typical. Time to metamorphosis is dependent upon how long it takes to grow to a particular size. At 14-16 centimeter total length, larvae begin metamorphosis to the ocean-going adult form. Metamorphosis occurs over multiple months, and requires physiological changes from sessile filter-feeder to active predator, including changes in sensory system (such as growing eyes), digestive system, and tolerance to sea water. Downstream migration appears correlated with high flow events of winter and spring. Adults spend up to four years in the ocean where feeding is by parasitism: an individual latches to its prey (usually fish, but sometimes marine mammals), rasps a hole through the skin, extracts body fluids and flesh, and finally drops off once full. Upmigration from the ocean occurs from winter through early summer, although lamprey may hold in a river up to a year before the final migration into spawning streams. Once the spawning migration starts, lamprey stop eating. Pacific lamprey do not appear to home to a natal stream, instead following the smell of pheromones produced by ammocoetes to find suitable spawning habitat. In late spring through early summer, nests are constructed, and while some adults may survive to return to the ocean, most die soon after spawning.

Specifics of the general Pacific lamprey life cycle as applied to the Klamath River system, much less its individual tributaries, are largely uncertain. Initial movement of spawners from the ocean into the river may occur at any time of the year, but is primarily late winter and into spring (Larson and Belchik 1998, Close, *et al*. 2010). Additionally, there is evidence of at least two distinct runs: a spring run that spawns shortly after entering freshwater, and a fall run that holds over and spawns the following spring (Anglin 1994). Downstream emigration of lamprey occurs year-round, with final outmigration to saltwater of transformed adults in late fall through spring (Anglin 1994; Close, *et al*. 2010). Other particulars, such as details about the ammocoete stage and spawning specifics (i.e., months, locations) for the various Klamath River tributaries, are unknown.

Habitat for Pacific lamprey ammocoetes is very important due to the long in-stream residence. Sands and silts are the preferred habitat of larvae, with larger substrate sizes utilized by larger (older) individuals (Sugiyama and Goto 2002; Stone and Barndt 2005). Finer particles are endemic of lower velocity environments such as stream margins, backwaters, eddies, and pools. Although ammocoetes are often considered to be sedentary, they will actively seek new habitat if a particular site becomes unsuitable (Moyle 2002; USFWS 2010). Most important is that the stream velocity has to be fast enough to allow filter feeding, yet sufficiently slow to retain the preferred sediments (Torgensen and Close 2004). For poorly known reasons, distribution of lamprey larvae in a stream tends to be patchy – not all suitable habitats are utilized – but it may be a function of microhabitat, variation between

stream reaches, and seasonal movement to take advantage of different habitat (Sugiyama and Goto 2002; Torgensen and Close 2004). Optimal temperature requirements for ammocoetes, as well as other water quality parameters, needs further study. However, it is known that eggs will successfully hatch from 10° to 22°C, with highest survival 10° to 18°C; and that local spawning peaks are likely tied with water temperatures most advantageous for embryo development (Meeuwig, *et al*. 2005).

Pacific lamprey spawning habitat is very similar to that required by salmonids. Redds are generally built in gravel and cobble substrates, with moderate velocity flowing water. Of the 125 Pacific lamprey nests surveyed in the Smith River, Oregon, most were observed in low gradient riffles, pool tailouts and lateral scour pools (Gunckel, *et al*. 2009). Most of these nests were associated with cover, including gravel and cobble substrates, vegetation and woody debris. Likewise, nests observed elsewhere have also largely associated with pool-tail outs, low gradient riffles and runs, including Cedar Creek, Washington (Stone 2006) and various tributaries within the Willamette River basin, Oregon (Mayfield, *et al*. 2014). Spawning activity has been observed to commence in association with the descending limb of the spring hydrograph once water temperature exceeds 10ºC, and be at its most intense between 10ºC and 15ºC (Mayfield, *et al*. 2014). Upstream extent of spawning Pacific lamprey is often considered synonymous with salmonid anadromy, although there are indications that this assumption may not always be true – under natural conditions, lamprey may be able to pass traditional barriers to upmigrating steelhead and salmon, such as waterfalls (USFWS 2012). Research is on-going on this topic. Until consensus is reached within the scientific community, it is appropriate to continue to utilize salmonid anadromy as Pacific lamprey extent.

Pacific lamprey numbers in the Klamath River appear to be decreasing. While there is no estimate of the current population, oral history taken from tribal fishers indicates a long-term decline in adult catch (Larson and Belchik 1998; USFWS 2012). A downward trend is suggested for outmigrating juveniles caught in rotary screw traps in the Klamath River basin between 1997 and 2004 (USFWS 2004). The Scott River and Shasta River rotary screw trap datasets (2001-2015) also exhibit long-term declines (B. Chesney, pers. comm.)

Klamath River Lamprey (*Entosphenus similis*)

Klamath River lamprey are found in the upper and lower Klamath River system, including its tributaries (Moyle 2002). This species is non-migratory and can be found within both rivers and lakes (Moyle 2002; CWS 2013). Klamath River lamprey is a Sensitive species for the Klamath National Forest.

Specifics concerning the life history and habitat needs of the Klamath River lamprey are few, but it is presumed to be broadly similar to the Pacific lamprey. One primary difference is that this species is limited to freshwater (i.e., is not anadromous), and therefore adults feed on prey such as salmonids, suckers, and cyprinids throughout their life (Moyle 2002; CWS 2013). Downstream of Iron Gate Dam, the distribution of Klamath River lamprey is presumed to be similar to anadromous salmonids, its primary food source (CWS 2013).

All Locations – Lamprey Surveys

Understanding of the full extent of distribution of Sensitive lamprey species within Project area waterways is unknown. In the Scott River, Pacific lamprey and Klamath river lamprey are annually captured in the CDFW rotary screw trap located just upstream of Scott Bar, the former appearing to comprise a larger proportion of the population than the latter (most recent report: Debrick and Stenhouse 2014). Other observations in the lower Scott River include 1995 and 2009 during spring

Chinook/summer steelhead census snorkel surveys (QVIR 2010; USFS unpub. data). More recently, ammocoete surveys (*Entosphenus ssp*.) were conducted in the Scott River drainage – within or near the Project area, sampling occurred on mainstem Scott River, Canyon Creek, and Kelsey Creek (USFS 2015).

Rearing for *Entosphenus ssp*. has been documented in the mainstem Scott River (USFS 2015). As it is not possible at this time to tell apart live Pacific lamprey and Klamath River lamprey under field conditions, the proportions and specific locations where each may be found is unknown. Lamprey of an appropriate age/size to be distinguished to species are captured in the CDFW rotary screw trap. However, as the trap is a passive capture device of drifting organisms, it is not possible to determine origination other than "Scott River drainage". Although lamprey spawning has not been directly observed in the Scott River, it is presumed to be available due to the presence of suitable habitat for multiple salmonid species.

Lamprey presence in Canyon Creek and Kelsey Creek is unknown. Ammocoete presence is unlikely, but appropriate habitat is present for spawning. Juvenile surveys occurred in 2015 within both creeks with negative results. Only two surveys (each stream) were conducted; and a third is suggested for highest confidence to declare a system not supportive for rearing (Reid and Goodman 2015). In addition to limitations regarding suitable rearing habitat in both creeks, these systems are unlikely to provide the strong support for development of the drifting organic food required for ammocoete filter feeding (USFS 2015). Concerning spawning, adult lamprey are attracted to the bile secretions of ammocoetes (and not necessarily their own species) to home in on rearing habitat. However, it is unknown how far adults will stray from these rearing areas to spawn. Distance is not thought to be far, but there is no quantitative data (S. Reid, pers. comm.). Lamprey are slow colonizers, but in systems which do not have barriers, nor recently (<10 years) removed barriers, extent of lamprey distribution is expected to be at a maximum (Close, *et al*. 2010).

Boulder Creek is not considered to be suitable habitat for lamprey. Although Boulder Creek is not judged to be an anadromous system (see salmonid discussion), the mouth may be accessible to adult lamprey. However, the creek is a very high gradient, high energy system within which no suitable ammocoete rearing habitat is available. While some pockets of spawning habitat is present for resident rainbow trout, these areas are small in extent with very patchy distribution subject to change on an annual basis due to regular scouring flows from spring run-off events (pers. obs.). Therefore, lamprey spawning is not expected.

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Personal Communication
Stewart Reid – Western Fishes (Ashland, OR)

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Appendix C: Table of Pathway and Indicators

Klamath National Forest Matrix: Table of Population and Habitat Indicators for Use on the Klamath National Forest in the Northwest Forest Plan Area

Aquatic Habitat Conditions Analysis Guidelines

AP = Analytical Process for Developing Biological Assessments for Federal Actions Affecting Fish within the Northwest Forest Plan Area (USDI, USDA, and NOAA 2004).
Available at www.blm.gov/or/esa/reports/Analytical_Process_110504.doc.

The table(s) within this Appendix show criteria used to determine baseline conditions in 7th-and 5th-field watersheds within the KNF boundaries **that contain anadromous fish habitat**. The criteria in the Table and footnotes are used to describe the current condition of Klamath Mountains watersheds, and to determine if projects are likely to affect anadromous salmonids via effects on salmonid habitat components. Current conditions of watershed(s) are assessed and documented in the Table of Habitat Indicators; and effects to Indicators from proposed actions are discussed in the narrative within the BA/BE and summarized in the Table of Habitat Indicators.

The initial KNF-NMFS Level 1 review of the Table criteria was completed by Perrochet, Thomas, and Flickinger in April 2007. Edits to LWD were made in March 2009 to reflect LRMP EIS values. The Table was updated in 2004 as part of the Analytical Process for ESA consultation with NMFS. In May 2012 Grunbaum and Meneks provided updates/edits to this document and the Table of Habitat Indicators.

The Table, as designed in the 2004 Analytical Process, and in earlier versions (1997 NMFS BO for the LRMP), suggests values to determine a level of functioning for anadromous fish bearing streams. A note about rigid values to assess level of functioning: in addition to fixed habitat parameters not allowing for natural variability, fixed habitat parameters set standards that may be geomorphically inappropriate (Bisson et al. 1997). Variability is an inherent property of aquatic ecosystems in the Pacific Northwest and habitats at any given location will change from year to year, decade to decade, and century to century (Bisson et al. 1997). Healthy lotic ecosystems require different parts of the channel system to exhibit very different in-channel conditions and that those conditions change through time (Reid and Furniss 1998). Also, data may not be available for the stream being assessed. Therefore, a conclusion of function must be evaluated with professional judgment recognizing the streams capability to perform within rigid values. In some cases, a stream's morphology, aspect or size may not support "Properly Functioning" criteria values for one or more habitat Indicators. If an Indicator for a particular stream is determined to be functioning at its capability (due to morphology, aspect, or size), it is rated as Properly Functioning even if it doesn't meet Table criteria values. In the absence of available data, table and associated footnotes suggest factors that should be considered when evaluating indicators.

Klamath National Forest Tributaries Table of Pathways and Indicators

Klamath National Forest Tributaries Table of Pathways and Indicators:				
Pathways	***Indicators***	***Properly Functioning***	***At Risk***	***Not Properly Functioning***
Habitat: Non Watershed Condition Indicators				
Water Quality:	Temperature **(1)**			
	1st - 3rd Order Streams [instantaneous]	69 F degrees (~ 20.5 C) or less	> 69 to 70.5 degrees F	70.5 F degrees (~ 21.3 C) or more
	4th-5th Order Streams [Maximum Weekly Maximum Temperature]	70.5 F degrees (~ 21.4 C) or less	> 70.5 to 73.5 degrees F	73.5 F degrees (~ 23.0 C) or more
	Suspended Sediment/Turbidity	Little to no quantitative turbidity data exists for streams on the Klamath National Forest. Use the following criteria to infer condition of turbidity Indicator: (1) professional judgment from years of direct observation of tributary streams; (2) amount of fines in substrate from stream survey data, (3) CWE modeled level of watershed surface erosion and mass wasting, and (4) condition of stream buffer RR and channel (particularly if there has been recent debris flows that altered the channel). Professional judgment of turbidity is based on observations of water clarity after peak flows in tributaries to the mainstems of the Klamath, Scott, and Salmon Rivers that have watersheds with varying degrees of disturbance from nearly pristine to highly disturbed. Properly Functioning: Water clarity returns quickly (within three days) following peak flows.	Water clarity slow (four to six days) to return following peak flows, moderate to high fines in substrate, moderate modeled surface erosion and mass wasting, and riparian reserves are not fully functioning.	Water clarity poor for long periods of time (one week or more) following peak flows. Some suspended sediments occur even at low flows or base flow. High fines in substrate, stream buffers in poor condition, high modeled surface erosion and mass wasting, and riparian reserves are in poor condition.
	Chemical/Nutrient Contamination **(2)**	Scott, Salmon, and Klamath River mainstems: Low levels of contamination from agriculture, industrial, and other sources; no excess nutrients. No CWA 303d designated reaches. Scott, Salmon, and Klamath River tributaries: None or low levels of chemical and/or nutrient contamination from agriculture, industrial, and other sources; no excess nutrients.	Scott, Salmon, and Klamath River mainstems: Moderate levels of contamination from agriculture, industrial, and other sources; some excess nutrients. One or more CWA 303d designated reaches Scott, Salmon, and Klamath River tributaries: Moderate levels of contamination from agriculture, industrial, and other sources and/or moderate excess nutrients.	Scott, Salmon, and Klamath Rivers: mainstems: High levels of contamination from agriculture, industrial, and other sources; high levels of nutrients. One or more CWA 303d designated reaches Scott, Salmon, and Klamath River tributaries: High levels of contamination from agriculture, industrial, and other sources and/or moderate to high excess nutrients.
Habitat Access:	Physical Barriers (AP)	Any man-made barriers present in watershed allow upstream and downstream passage at all flows.	One or more human -made barriers present in watershed do not allow upstream and/or downstream passage at base/low flows.	Human-made barriers present in watershed do not allow upstream and/or downstream passage at a range of flows for at least one life history stage.

Klamath National Forest Tributaries Table of Pathways and Indicators:

Pathways	*Indicators*	*Properly Functioning*	*At Risk*	*Not Properly Functioning*
Habitat Elements:	Substrate character **(3)**	Use stream survey data for determining substrate character. In addition, use USLE and GEO models to determine functioning level of Indicator and potential effects of sediment delivery to streams that may affect anadromous fish and their habitat. Can also infer substrate character functioning level from other factors such as high road density and hydrologic connection, recent large intense wildfires, and recent (last 20 years) altered channel.		
		Less than 15% fines (<2 mm) in spawning habitat (pool tail-outs, low gradient riffles, and glides) and cobble embeddedness less than 20%. Additional desired conditions, as per TMDL/NCRWB water quality compliance, include: *Pool sediment vol (V*): ≤21% *Subsurface, <0.85 mm: ≤14% *Subsurface, <6.4 mm: ≤30%	15% or greater fines (<2 mm) in spawning habitat (pool tail-outs, low gradient riffles, and glides) and/or cobble embeddedness is 20% or greater.	Greater than 20% fines (<2 mm) in spawning habitat (pool tail-outs, low gradient riffles, and glides) and cobble embeddedness greater than 25%.
	Large Woody Debris **(4)**	See KNF LRMP EIS Chapter 3, text and tables on Pages 68-69. For stream reaches on the Westside of the Forest, manage for an average of 20 pieces of large wood per 1,000 ft in 3-5th order streams (LRMP Page 4-143). Large wood is defined as a minimum length of 50 feet and diameter of 24 inches on the Westside. However, site potential and channel width must be considered rather than using strict numbers. Also consider the potential for future LWD recruitment in both the short- and long-term.	Current levels are being maintained at minimum levels desired for "properly functioning" but potential sources for long term woody debris recruitment are lacking to maintain these minimum values.	Current levels are not at those desired levels for "properly functioning" and potential sources of woody debris for short and/or long term recruitment are lacking.
	Pool Quality and Frequency **(5)**	At least one primary pool every three to seven bankfull channel widths. In 1st through 3rd order streams, a primary pool must have a maximum depth of two feet or greater. In 4th and 5th order streams, a primary pool must have a maximum depth of three feet or greater. In 6th order and larger streams, a primary pool must have a maximum depth of four feet or greater.	At least one pool every three to seven bankfull channel widths. At least half of the pools are primary pools. At least half the pools have a maximum depth of at least 24 inches (1st- 3rd order streams) or 36 inches (4th order and greater).	There is less than one pool every three to seven bankfull channel widths and/or less than half the pools have maximum depth of at least 24 inches (1st-3rd order streams) or 36 inches (4th order and greater).
	Off-Channel Habitat	Fish have unrestricted access to off-channel habitats (such as oxbows, off-channel ponds, backwaters, and areas of low flow velocity and cover) in unconstrained reaches during high flows and flooding events in winter. And these off-channel areas are relatively undisturbed by dikes, levees, dredge tailings, roads, excavations, fills, flow diversions, development, vegetation clearing, wood removal, poor water quality, etc.	Fish access to off-channel habitats, and the quantity and quality of off-channel habitats, in unconstrained reaches, is diminished due to dikes, levees, dredge tailings, roads, excavations, fills, flow diversions, development, vegetation clearing, wood removal, poor water quality, etc.	Fish access to off-channel habitats in unconstrained reaches is severely restricted or impossible due to dikes, levees, dredge tailings, roads, excavations, fills, flow diversions, development, etc., and/or the quality of the off-channel habitats is poor due to vegetation clearing, wood removal, poor water quality, and the other factors listed above. .

Klamath National Forest Tributaries Table of Pathways and Indicators:				
Pathways	***Indicators***	***Properly Functioning***	***At Risk***	***Not Properly Functioning***
Habitat Elements:	Refugia (important remnant habitat for sensitive aquatic species)	Critical habitats necessary for successful completion of all anadromous salmonid life history phases (spawning, incubation, emergence, freshwater rearing, and migration) are functioning, accessible, and well-distributed. Critical summer refugia in Klamath Mountain streams include: (1) thermal refugia and (2) anadromous stream reaches with intact riparian reserves, cool clean water, pools that are not filled-in or partially filled-in with excess sediment, adequate stream flows, and good water quality. Critical winter habitat for anadromous salmonids includes side channels, off-channel habitats, and floodplain habitats.	Not all critical habitats necessary for successful completion of all anadromous salmonid life history phases are functioning and/or accessible for salmonids and/or well-distributed. Habitat quality and/or accessibility is diminished due to dikes, levees, dredge tailings, other fills, roads, excavations, flow diversions, development, vegetation clearing, wood removal, poor water quality, etc.	Many of the critical habitats necessary for successful completion of all anadromous salmonid life history phases are not functioning and/or not accessible for salmonids, and are thus are poorly distributed across the stream network and not providing adequate biological connectivity.
Channel Condition and Dynamics:	Width/Depth Ratio **(6)**	Width-to-Depth ratio < 12 on all reaches that could otherwise best be described as 'A', 'G', and 'E' channel types. Width-to-Depth ratio > 12 on all reaches that could otherwise best be described as 'B', 'F', and 'C' channel types. No braided streams formed due to excessive sediment loads. Lacking data, width-to-depth ratio should be evaluated considering the following factors: (1) recent (last 20 years) history of debris flows that have scoured channel and resulted in aggradation or degradation of the stream bed, (2) recent history of mass wasting that delivered large volumes of sediment to the stream that may have filled in pools, (3) pool frequency and depth information from stream surveys, (4) watershed disturbance as estimated with CWE modeling for mass wasting (GEO) and peak flows (ERA/TOC), and (5) frequency of large woody debris in the stream channel. For properly functioning, stream crossing density is low, there have been few mass wasting events caused by management actions, there are numerous deep pools, modeled mass wasting and surface erosion is low, and there is adequate LWD. If there is no or little management disturbance legacy in a watershed, then width-to-depth ratio is assumed to be properly functioning.	More than 10% of the reaches are outside of the ranges given for Width/Depth ratios for the channel types specified in "Properly Functioning" block. Braiding has occurred in some alluvial reaches as a result of excessive aggradation due to high sediment loads. For at-risk, stream crossing density is moderate to high, there have been some mass wasting events caused by management actions, pool frequency and quality is at-risk, modeled mass wasting and surface erosion is moderate to high, and there is inadequate LWD.	More than 25% of the reaches are outside of the ranges given for Width/Depth ratios for the channel types specified in "Properly Functioning" block. Braiding has occurred in many alluvial reaches as a result of excessive aggradation due to high sediment loads. For not properly functioning, stream crossing density is high, there have been some large mass wasting events caused by management actions, pool frequency and quality is poor, modeled mass wasting and surface erosion is moderate to high, and there is inadequate LWD.

Klamath National Forest Tributaries Table of Pathways and Indicators:

Pathways	***Indicators***	***Properly Functioning***	***At Risk***	***Not Properly Functioning***
	Streambank Condition (AP)	> 80% of any stream reach has ≥ 90% stability. Most watersheds have no bank stability surveys data so the level of streambank stability should be evaluated by considering: (1) density of road-stream crossings per stream or stream reach, (2) amount of inner gorge road, (3) other clearing and/or compaction directly adjacent to the stream, (4) artificial banks created by pushing up berms, and (5) recent (since 1996) channel altering debris flows. For properly functioning: Stream crossing density is low to moderate, there is little to no inner gorge road, there is no or only minor disturbance next to the stream channel, there are few or no berms, dikes, or levees constraining the channel, and/or there has been no or minor channel alteration/filling due to debris flows/landslides related to past management actions.	50-80% of any stream reach has ≥ 90% stability. For at-risk: Stream crossing density is moderate to high, there is some inner gorge road, there is some disturbance next to the stream channel, there are some berms, dikes, or levees constraining the channel, and/or there has been some channel alteration/filling due to debris flows/landslides related to past management actions.	< 50% of any stream reach has ≥90% stability For not properly functioning: Stream crossing density is high, there is over a mile of inner gorge road, there is significant disturbance next to the stream channel, berms, dikes, or levees constrain over a mile of channel; and/or there has been significant channel alteration/filling due to debris flows/landslides related to past management actions.
	Floodplain Connectivity (AP)	Off-channel areas are frequently hydrologically linked to main channel; overbank flows occur and maintain wetland functions, riparian vegetation, and succession.	Reduced linkage of wetland, floodplains, and riparian areas to main channel; overbank flows are reduced relative to historic frequency, as evidenced by moderate degradation of wetland function, riparian vegetation/succession.	Severe reduction in hydrologic connectivity between off-channel, wetland, floodplain, and riparian areas; wetland area drastically reduced and riparian vegetation/succession altered significantly.
Flow / Hydrology:	Change in Peak/Base Flows **(7)**	Properly functioning watersheds for peak flow have low modeled ERA/TOC, low road density, few large clearings in the rain-snow transition zone, and vegetation close to reference condition. Properly functioning watersheds for base flow have low modeled ERA/TOC, low road density and hydrologic connectivity, and vegetation close to reference condition.	Watersheds at-risk for change in peak flow have moderately high to high modeled ERA/TOC, moderate to high road density, and/or some large recent clearings in the rain-snow transition zone. Watersheds at-risk for change in base flow have denser vegetation compared to reference conditions, several water diversions, and moderate density of roads that have hydrologic connectivity.	Watersheds not properly functioning or change in peak flow have high modeled ERA/TOC, high road density, and may have large recent clearings in the rain-snow transition zone. Watersheds not properly functioning for change in base flow have much denser vegetation compared to reference conditions, numerous or large water diversions, and high density of roads that have hydrologic connectivity.
	Increase in Drainage Network (AP)	Zero or minimum increases in active channel length correlated with human caused disturbance (e.g., trails, ditches, compaction, impervious surface, etc). The primary cause of drainage network increase in Klamath Mountain watersheds is hydrologic connectivity between the road system and the stream network.	Low to Moderate increases in active channel length correlated with human caused disturbance (e.g., trails ditches, compaction, impervious surface, etc).	Greater than moderate increase in active channel length correlated with human caused disturbance (e.g., trails ditches, compaction, impervious surface, etc).

Klamath National Forest Tributaries Table of Pathways and Indicators:				
Pathways	***Indicators***	***Properly Functioning***	***At Risk***	***Not Properly Functioning***
Watershed Condition <u>Indicators</u>				
Watershed Conditions:	Road Density and Location (AP)	Less than 2 miles per square mile.	Two to three miles per square mile.	Over 3 miles per square mile.
	Riparian Reserves – NW Forest Plan (AP) **(8)**	The riparian reserve system provides adequate shade, large woody debris recruitment, and habitat protection and connectivity in all subwatersheds, and buffers or includes known refugia for sensitive aquatic species (> 80% intact), and/or for grazing impacts; percent similarity of riparian vegetation to the potential natural community/composition > 50%.	Moderate loss of connectivity or function (shade, LWD recruitment, etc) of riparian reserve system, or incomplete protection of habitat and refugia for sensitive aquatic species (approx. 70-80% intact), and/or for grazing impacts; percent similarity of riparian vegetation to the potential natural community/composition 25-50% or better. Some past stand-replacement timber harvest or intense fire in RR, moderate road and landing density in RR, minor to moderate level of mining in RR, vegetation/fuels moderately departed from historic fuels conditions, species diversity and vegetation structure in stream buffers moderately altered from reference condition due to fire suppression and past timber harvest, and moderate modeled CWE values.	Riparian reserve system is fragmented, poorly connected, or provides inadequate protection of habitat and refugia for sensitive aquatic species (approx. less than 70% intact), and/or for grazing impacts; percent similarity of riparian vegetation to the potential natural community/composition is 25% or less. Extensive past stand-replacement timber harvest or intense fire in RR, high road and landing density in RR, moderate to high intensity of mining in RR, vegetation/fuels greatly departed from historic fuels conditions, species diversity and vegetation structure in stream buffers significantly altered from reference condition due to fire suppression and past timber harvest, and high modeled CWE values.
	Disturbance History/Regime	Frequency, duration, and magnitude of stochastic disturbance events are close to reference condition. The following factors should be considered in rating the Watershed Disturbance/Regime indicators: (1) overall watershed disturbance as determined through CWE modeling, (2) road density and location, (3) current impacts from past stand-replacing forestry, mining, and intense fires, (4) departure from historic fire regime, (5) departure from historic vegetation structure and composition, and (6) character of development on private property. For properly functioning, a watershed should have low CWE and road density (all models under "1" threshold), few impacts from past stand-replacement forestry or intense fire, are not significantly departed from historic vegetation/fuels condition and fire regime, and/or have low disturbance on private property.	In at-risk watersheds, frequency, duration, and magnitude of stochastic disturbance events are moderately departed from reference condition. At-risk watersheds have moderate to high CWE and road density (one or two models over "1" threshold), some significant impacts from past stand-replacement forestry or intense fire, are moderately departed from historic vegetation/fuels condition and fire regime, and/or have moderate disturbance on private property.	In not properly functioning watersheds, frequency, duration, and magnitude of stochastic disturbance event is significantly departed from reference condition. Not properly functioning watersheds have high CWE and road density (all models over "1" threshold), significant impacts from past stand-replacement forestry or intense fire, are significantly departed from historic vegetation/fuels condition and fire regime, and/or have significant disturbance on private properties.
Summary Integration of all species and habitat indicators effects	How do the effects to indicators affect each fish species and their habitat? Describe by species and by 7th and 5th field watersheds. See AP guidance. In addition to the narrative summary, use Summary Table in Tables required for BA/BE.			

Footnotes to Table Above: *Table of Population and Habitat Indicators For Use on the Klamath National Forest in the Northwest Forest Plan Area, as adjusted from Appendix A in the Analytical Process*.

1) (Temperature) Proper Functioning criteria for 4th -5th Order streams is derived from temperature monitoring near the mouth of streams of relatively undisturbed watersheds (Clear, Dillon, and Wooley Creeks). –Maximum Weekly Maximum Temperatures (MWMT) as high as 70.5 degrees F have been recorded on these streams (EA Engineering, 1998 Salmon River and Dillon Creek Watershed Fish Habitat and Channel Type Analysis, Appendix 2). At-Risk criteria for 4th/5th order streams is derived from monitoring in streams that support populations of anadromous fish, although temperatures in this range (70.5 to 73.5 degrees F) are considered sub-optimal. The Not Properly Functioning criterion is sustained temperatures above 73.5 degrees F - that causes cessation of growth and approach lethal temperatures for salmon and steelhead. Properly Functioning criteria for 1st - 3rd order streams is derived from Desired Future Conditions (DFC) values given in the LRMP EIS p 3-68. At Risk and Not Properly Functioning criteria for 1st – 3rd order streams are assigned on a temperature continuum with values given for 4th/5th order streams, with the maximum instantaneous temperature of At Risk 1st - 3rd order streams coinciding with the minimum MWMT of 4th/5th order At Risk streams. [Stream Order according to Strahler (1957).]

(2) (Chemical/Nutrient Contamination) For projects within the river corridors of the mainstem Scott, Salmon, and Klamath Rivers the criteria is unchanged from AP Table. For tributaries to the Scott, Salmon, and Klamath Rivers use the criteria from the AP table. Although these tributaries have CWA 303d designation, Klamath National Forest tributaries are typically properly functioning for dissolved oxygen, nutrients, and microcystin, and because temperature and sediment is assessed in the Temperature and Substrate Character Indicators. Chemical contamination and nutrients should be assessed for Scott, Salmon, and Klamath River tributaries.

(3) (Substrate Character) Use recent stream survey data where available. Properly Functioning criteria for % fines in gravel is from the LRMP EIS p 3-68. Additional Forest-wide desired conditions for sediment (pool sediment, subsurface sediment) are described by Laurie and Elder (2012) in relation to monitoring for TMDL and NCRWB water quality standards. When location-specific information is unavailable, use the following as best appropriate: use USLE and GEO models to determine functioning level of Indicator and potential effects of sediment delivery to streams that may affect anadromous fish and their habitat, infer substrate character functioning level from other factors such as high road density and degree of hydrologic connection, recent large intense wildfires, and recent (last 20 years) debris flows that altered channels, and lastly use professional judgment to describe existing conditions and to estimate effects based upon model output interpretation, research results, or other information. The KNF CWE modeling procedure describes the risk (probability) of project-caused sediment production (see 2004 CWE process paper, by Elder and Reichert, in fisheries sufficiency guides). For existing condition and effects of the action:

1. Properly Functioning: USLE and GEO values are less than 1.0
2. At Risk: USLE and GEO values are between 1.0-1.20
3. Not Properly Functioning: USLE and GEO values are greater than 1.20

(4) (Large Woody Debris) See KNF LRMP EIS Chapter 3, text and tables on Pages 68-69. For stream reaches on the Westside of the Forest, manage for an average of 20 pieces of large wood per 1,000 ft in 3-5th order streams (LRMP Page 4-143). Large wood is defined as a minimum

length of 50 feet and diameter of 24 inches on the Westside. However, site potential and channel width must be considered rather than using strict numbers. Also consider the potential for future LWD recruitment in both the short- and long-term.

Criteria for length of LWD for larger streams may be based on average bankfull channel width of the reach: in streams larger than 3rd order a piece of woody debris may qualify as large woody debris in a stream reach if its length is 1.5 times the average bankfull channel width, or if it has a rootwad attached and its length is 1¼ times the average bankfull channel width. Stable pieces of woody debris remain stationary during normal to high flows. Channel width and depth largely determines whether large woody debris recruited into a stream reach will be stable, and largely determines the average size of wood retained in streams (Bilby and Ward 1989, 1991; Robison and Beschta 1990). As channels become wider and deeper, the average size of a stable piece of wood increases. Pieces shorter than bankfull width and with a diameter less than bankfull depth are more likely to be transported out of a reach by streamflow (Bilby 1984, Braudrick et al. 1997). Length of woody debris appears to be most important to its stability where stream discharge is sufficient to float large diameter stems (Bilby 1985, Swanson and others 1984). Branches and/or rootwads, if still attached, add to the stability of woody debris. Therefore, criteria for length of LWD for larger streams may be based on average bankfull channel width of the reach: in streams larger than 3rd order a piece of woody debris may qualify as large woody debris in a stream reach if its length is 1.5 times the average bankfull channel width, or if it has a rootwad attached and its length is 1¼ times the average bankfull channel width.

(5) (Pool Quality and Frequency) A measurable pool is an area of channel which (1) shows clear signs that the pool was created by scour at high flows and/or that the pool is the result of the channel being dammed at the downstream end; (2) has a significant residual depth - the deepest part of the pool must be at least twice as deep as the water flowing out of the pool at the riffle crest; (3) has an essentially flat water surface during low flow - water surface slope <0.05 percent; and (4) includes most of the channel - it must include the thalweg and occupy at least half of the width of the low-flow channel. "Primary" pools are defined by their maximum depth in relationship to size or stream order. As the order or size of the stream increases the required minimum depth for a primary pool increases. In 1st through 3rd order streams, a primary pool must have a minimum depth of two feet or greater. In 4th and 5th order streams, a primary pool must have a minimum depth of three feet. In 6th order and larger streams, a primary pool must have a minimum depth of four feet.

(6) (Width/Depth Ratio) The Width-to-Depth ratio for various channel types is based on delineative criteria of Rosgen (1996). Properly Functioning means that Width-to-Depth ratio falls within expected channel type as determined by the other four delineative factors (entrenchment, sinuosity, slope, and substrate). Aggradation on alluvial flats causing braiding is well known phenomenon that often accompanies changes in Width-to-Depth ratio as watershed condition deteriorates. Stream width is a function of streamflow occurrence and magnitude, size and type of transported sediment, and the bed and bank materials of the channel (Rosgen 1996). Channel widths generally increase with flow volume downstream. Channel widths can be modified by changes in riparian vegetation, landslides particularly debris flows, changes in streamflow regimes, and changes in sediment supply. The AP Table indicates that confined or entrenched channel types (such as A, G, and E types) are Properly Functioning when Width-to-Depth ratios are <12, and wider channel types (such as B, C, and F types) are Properly Functioning when

Width-to-Depth ratios are >12. To meet the Properly Functioning criteria channels must also have no or minimal braiding due to excessive sediment.

(7) (Peak/Base Flows) In most cases, sufficient hydrograph data is not available to determine comparative changes in peak flows as suggested in the AP. Infer changes in **peak flows** when no hydrograph data is available by considering the following factors: (1) CWE runoff model (ERA/TOC) outputs, (2) road density and the degree of hydrologic connectivity between the road system and the stream network, and (3) number, size, and vintage of openings in the forest canopy resulting from past stand-replacement forestry in the snow-rain transition zone where increased openings can result in elevated runoff from rain-on-snow events. The potential for decreased **base flows** in the Project HUC7 watersheds should be evaluated by considering the following factors: (1) increased/decreased evapotranspiration due to denser/sparser vegetation than reference condition that has resulted from stand-replacement forestry and/or fire suppression, (2) number and size of water diversions, and (3) degree of hydrologic connectivity between the road system and the stream network (watersheds with high road density likely have reduced base flows due to impervious surfaces and groundwater interception in road cuts).

(8) (Riparian Reserves) The following factors should be considered in determining the condition of stream buffer (hydrologic) RR: (1) amount and age of past stand-replacement forestry or intense fire in stream buffers, (2) road and landing density in stream buffers, (3) mining in stream buffers, (4) departure from historic fire regime, (5) condition of riparian vegetation for providing shade, large woody debris, sediment-filtering, and nutrient cycling, and (6) the amount of overall disturbance in the watershed particularly as estimated by the peak flow (ERA) and mass wasting (GEO) models. The following two factors should be considered in determining the condition of geologic RR: (1) amount and age of past stand-replacement timber harvest and/or recent intense wildfire on geologic RR and (2) road and landing density on geologic RR.

Appendix D: Environmental Baseline and Proposed Effects Checklist

Checklists for documenting environmental baseline and effects of proposed actions(s) on relevant indicators for

LOVER'S CANYON PROJECT

Legend For Reference Information Used to Determine Baseline Conditions:

ND: No data
N/A: Not applicable
PJ: Professional judgment (M. Meneks – District Fish Biologist)
CDFW 2015: Passage assessment database query
Sed 2016: Sediment monitoring, KNF – 2009 to 2015 (USFS 2016)
WQ 2012: Stream temperature monitoring, KNF – 2010 and 2011 (USFS 2012)
WA 2000: Lower Scott Ecosystem Analysis (USFS 2000)
Coho-Sct 2014: SONC Coho Recovery Plan, Chapter 36 – Scott River (NOAA 2014)

CDFW 2015: 2014 Scott River studies final report (Knechtle and Chesney 2015)
CDFW 2014: Outmigrant screw trap data for Scott River, 2014 (Debrick and Stenhouse 2014)

CWE: CWE data by watershed (see Table 4 in document text)

Temps: Summer temperature data (2010-2015) – Boulder Creek, Canyon Creek, Kelsey Creek, Scott River

USFS 2013a: Canyon Creek pool analysis report (USFS 2013a)
USFS 2013b: Boulder Creek pool analysis report (USFS 2013b)
USFS 2015a: Kelsey Creek stream survey report (USFS 2015a)
USFS 2015b: Boulder Creek wood debris investigation (USFS 2015b)

Canyon 2005: Canyon Creek survey data – 2005 (unpub. data)
Canyon 1999: Canyon Creek survey data – 1999 (unpub. data)
Canyon 1998: Canyon Creek survey data – 1998 (unpub. data)
Canyon 1997: Canyon Creek survey data – 1997 (unpub. data)

Kelsey 1997: Kelsey Creek survey data – 1997 (unpub. data)
Kelsey 1989: Kelsey Creek survey data – 1989 (unpub. data)

CA-EPA: http://www.swrcb.ca.gov/northcoast/water_issues/programs/tmdls/303d/

Table of Pathway and Indicators for 7th Field Watershed: Lower Canyon Creek (for Canyon Creek)

DIAGNOSTIC OR PATHWAY and INDICATOR	Environmental Baseline			Effects of the Action		
	PROPERLY FUNCTIONING	FUNCTIONING - AT RISK	NOT PROP. FUNCT.	RESTORE	MAINTAIN	DEGRADE
HABITAT:						
Habitat Quality Temperature	WQ 2012; Temps-Canyon				X	
Suspended Sediment - Intergravel DO/Turbidity	PJ; CWE; Sed 2016				X	
Chemical Contamination/ Nutrients	PJ				X	
Habitat Access Physical Barriers	PJ; CDFW 2015; FishPass 2001				X	
Habitat Elements Substrate Character and Embeddedness	CWE; Sed 2013; WA 2000; Canyon 2005, 1997				X	
Large Woody Debris			PJ; WA 2000		X	
Pool Frequency and Quality	USFS 2013a				X	
Large Pools						
Off-channel Habitat	PJ				X	
Refugia	PJ				X	
Channel Cond & Dyn Average Wetted Width/Maximum Depth	PJ; Canyon 2005, 1999, 1998, 1997				X	
Streambank Condition	PJ				X	
Floodplain Connectivity	PJ				X	
Flow/Hydrology Change in Peak/Base Flows	PJ; CWE				X	
Increase in Drainage Network	PJ				X	
Watershed Conditions Road Density & Location		WA 2000; GIS			X	
Disturbance History & Regime	PJ; CWE				X	
Riparian Reserves - Northwest Forest Plan		PJ; Coho-Sct 2014; WA 2000			X	
SPECIES AND HABITAT:						
Species and Habitat: Summary/Integration of all Species and Habitat Indicators		X			X	
	Due to lack of data, specific trend for anadromous fish in this subdrainage is unknown. However, some sources are available to examine the general Scott River condition. (1) Screw trap data since 2000 suggests a steady to upward trend for Chinook smolts and steady to slightly down for steelhead smolts (CDFW 2014). (2) Run size estimate for spawning Chinook since 1978 is steady to slightly down (CDFW 2015). Recent trends for Coho are unclear, but overall the run is considered to be depressed. See Life History section for additional information			See Env. Conseq. and Table 6 for an Indicator effects summary. The Env. Conseq. section also describes effects to fish and their habitat. Project will not cause adverse effects.		

Table of Pathway and Indicators for 7th Field Watershed: SF Kelsey Creek (for mainstem Kelsey Creek)

DIAGNOSTIC OR PATHWAY and INDICATOR	Environmental Baseline			Effects of the Action		
	PROPERLY FUNCTIONING	FUNCTIONING - AT RISK	NOT PROP. FUNCT.	RESTORE	MAINTAIN	DEGRADE
HABITAT:						
Habitat Quality Temperature	WQ 2012; Temps-Kelsey				X	
Suspended Sediment - Intergravel DO/Turbidity	PJ; CWE; Sed 2016				X	
Chemical Contamination/ Nutrients	PJ				X	
Habitat Access Physical Barriers	PJ; CDFW 2015; FishPass 2001[1]				X	
Habitat Elements Substrate Character and Embeddedness	CWE; USFS 2015a; Sed 2013; WA 2000; Kelsey 2005, 1997				X	
Large Woody Debris			USFS 2015a; WA 2000; Kelsey 1997		X	
Pool Frequency and Quality		PJ; USFS 2015a; WA 2000; Kelsey 1997, 1989			X	
Large Pools						
Off-channel Habitat	PJ				X	
Refugia	PJ				X	
Channel Cond & Dyn Average Wetted Width/Maximum Depth	PJ; USFS 2015a				X	
Streambank Condition	USFS 2015a				X	
Floodplain Connectivity	PJ				X	
Flow/Hydrology Change in Peak/Base Flows	PJ; CWE				X	
Increase in Drainage Network		PJ			X	
Watershed Conditions Road Density & Location		PJ; WA 2000; GIS			X	
Disturbance History & Regime	PJ; CWE				X	
Riparian Reserves - Northwest Forest Plan		PJ; Coho-Sct 2014; WA 2000			X	
SPECIES AND HABITAT:						
Species and Habitat: Summary/Integration of all Species and Habitat Indicators		X			X	
	Due to lack of data, specific trend for anadromous fish in this subdrainage is unknown. However, some sources are available to examine the general Scott River condition. (1) Screw trap data since 2000 suggests a steady to upward trend for Chinook smolts and steady to slightly down for steelhead smolts (CDFW 2014). (2) Run size estimate for spawning Chinook since 1978 is steady to slightly down (CDFW 2015). Recent trends for Coho are unclear, but overall the run is considered to be depressed. See Life History section for additional information			See Env. Conseq. and Table 6 for an Indicator effects summary. The Env. Conseq. section also describes effects to fish and their habitat. Project will not cause adverse effects.		

[1]Barriers in Kelsey Ck drainage are on SF Kelsey Creek, outside range of anadromy

Table of Pathway and Indicators for 7th Field Watershed: Boulder Creek (for Boulder Creek)

Boulder Creek supports resident rainbow trout, but is not considered to be habitat for anadromous species. However, is the stream does exhibit thermal refugia at its confluence with Scott River.

DIAGNOSTIC OR PATHWAY and INDICATOR	Environmental Baseline			Effects of the Action		
	PROPERLY FUNCTIONING	FUNCTIONING - AT RISK	NOT PROP. FUNCT.	RESTORE	MAINTAIN	DEGRADE
HABITAT:						
Habitat Quality Temperature	WQ 2012; Temps-Boulder				X	
Suspended Sediment - Intergravel DO/Turbidity	PJ; CWE				X	
Chemical Contamination/ Nutrients	PJ				X	
Habitat Access Physical Barriers	PJ; CDFW 2015; FishPass 2001[1]				X	
Habitat Elements Substrate Character and Embeddedness	CWE; Sed 2013				X	
Large Woody Debris	N/A for streams less than 3rd order; however, not properly functioning (USFS 2015b)				X	
Pool Frequency and Quality	USFS 2013b				X	
Large Pools						
Off-channel Habitat	N/A - Not present					
Refugia	PJ				X	
Channel Cond & Dyn Average Wetted Width/Maximum Depth	PJ				X	
Streambank Condition	PJ				X	
Floodplain Connectivity	PJ				X	
Flow/Hydrology Change in Peak/Base Flows	PJ; CWE				X	
Increase in Drainage Network	PJ				X	
Watershed Conditions Road Density & Location	PJ; GIS				X	
Disturbance History & Regime	PJ; CWE 2015				X	
Riparian Reserves - Northwest Forest Plan		PJ; Coho-Sct 2014			X	
SPECIES AND HABITAT:						
Species and Habitat: Summary/Integration of all Species and Habitat Indicators		X			X	
	Boulder Creek does not directly support anadromous species. Salmonids utilize the cool-water outflow as thermal refugia during the summer. See other matrices for general basin-wide conditions for Coho, Chinook, and steelhead.			See Env. Conseq. and Table 6 for an Indicator effects summary. The Env. Conseq. section also describes effects to fish and their habitat. Project will not cause adverse effects.		

[1]Culvert on Forest Road 44N45 upgraded in 2005 to allow unrestricted aquatics passage.

Table of Pathway and Indicators for 5th Field Watershed: Lower Scott River (for mainstem Scott River)

DIAGNOSTIC OR PATHWAY and INDICATOR	Environmental Baseline			Effects of the Action		
	PROPERLY FUNCTIONING	FUNCTIONING - AT RISK	NOT PROP. FUNCT.	RESTORE	MAINTAIN	DEGRADE
HABITAT:						
Habitat Quality Temperature			Temps-Scott		X	
Suspended Sediment - Intergravel DO/Turbidity		PJ			X	
Chemical Contamination/ Nutrients			CA-EPA		X	
Habitat Access Physical Barriers	CDFW 2015; Coho-Sct 2014				X	
Habitat Elements Substrate Character and Embeddedness			PJ[1,2]; Coho-Sct 2014		X	
Large Woody Debris			Coho-Sct 2014; WA 2000		X	
Pool Frequency and Quality	ND - likely altered due to historic mining practices				X	
Large Pools						
Off-channel Habitat		PJ[1]; Coho-Sct 2014			X	
Refugia		PJ[1]			X	
Channel Cond & Dyn Average Wetted Width/Maximum Depth	ND - likely altered due to historic mining practices				X	
Streambank Condition			PJ[1,2]		X	
Floodplain Connectivity		PJ[1]; Coho-Sct 2014			X	
Flow/Hydrology Change in Peak/Base Flows			PJ[1]; Coho-Sct 2014		X	
Increase in Drainage Network		PJ[1]			X	
Watershed Conditions Road Density & Location		WA 2000			X	
Disturbance History & Regime		PJ[1]; Coho-Sct 2014; WA 2000			X	
Riparian Reserves - Northwest Forest Plan		PJ; Coho-Sct 2014; WA 2000			X	
SPECIES AND HABITAT:						
Species and Habitat: Summary/Integration of all Species and Habitat Indicators		X			X	
	Sources available to examine the general Scott River condition for anadromous fish include: (1) Screw trap data since 2000 suggests a steady to upward trend for Chinook smolts and steady to slightly down for steelhead smolts (CDFW 2014). (2) Run size estimate for spawning Chinook since 1978 is steady to slightly down (CDFW 2015). Recent trends for Coho are unclear, but overall the run is considered to be depressed. See Life History section for additional information			See Env. Conseq. and Table 7 for an Indicator effects summary. The Env. Conseq. section also describes effects to fish and their habitat. Project will not cause adverse effects.		

[1]This 5th-field watershed includes extensive private property within/without the Forest boundary. Historic resource use throughout the drainage, including dredging, has impacted the watershed, and agriculture and timber extraction continue on private. Therefore, while Forest Service, or inholdings within the boundary, may show properly functioning condition - for instance, all CWE models under "1" threshold - the consideration of the *whole* 5th-field watershed suggest lower ratings. Data is largely lacking for private properties.

[2]Due to size of lower Scott River and extreme difficulty to survey, comprehensive datasets for physical attributes are not available.

References:

Debrick, A., and S. Stenhouse. 2014. Final report Shasta and Scott River juvenile salmonid outmigrant study, 2014. Report #P071307. California Department of Fish and Wildlife, Northern Region, Yreka, CA. 94 p.

Knechtle, M., and D. Chesney. 2015. 2014 Scott River salmon studies final report. California Department Fish and Wildlife, Northern Region, Yreka, CA. 25 p.

National Marine Fisheries Service (NOAA). 2014. Final Recovery Plan for the Southern Oregon/Northern California Coast Evolutionarily Significant Unit of Coho Salmon (*Oncorhynchus kisutch*). Chapter 36 – Scott River. National Marine Fisheries Service. Arcata, CA.

USDA Forest Service (USFS). 2016. Stream sediment monitoring on the Klamath National Forest, 2009-2012. Klamath National Forest, Yreka, CA. 26 p.

_____. 2015a. Kelsey Creek stream survey report. Klamath National Forest, Yreka, CA. 15 p.

_____. 2015b. Boulder Creek wood debris investigation (2015). Salmon-Scott River Ranger District, Klamath National Forest, CA. 5 p.

_____. 2013a. Canyon Creek pool analysis (2013). Salmon-Scott River Ranger District, Klamath National Forest, CA. 4 p.

_____. 2013b. Boulder Creek pool analysis (2013). Salmon-Scott River Ranger District, Klamath National Forest, CA. 4 p.

_____. 2012. Draft stream temperature monitoring on the Klamath National Forest, 2010 to 2011. Klamath National Forest, Yreka, CA. 17 p.

_____. 2000. Lower Scott Ecosystem Analysis. Scott River Ranger District, Klamath National Forest, Etna, CA. 156 p + appendices.

Appendix E: Post-Storm Addemdum Memo to the Biological Assessment

To: Don Flickinger, NOAA Fisheries West Coast Region

From: Maija Meneks, Salmon-Scott Rivers Ranger District, Klamath National Forest

Date: 09/05/2017

The purpose of the Lovers Canyon Project (LCP) is to improve compositional, structural, and functional attributes of the local forest ecosystem by: restoring processes; reducing risk of fire and promoting landscape-level fire resiliency; and providing a range of tangible and intangible serves, including wood products, biodiversity, and beneficial uses of water. Primary project components include: commercial harvest (tractor/skyline); pre-commercial thinning; roadside and ridgetop fuel treatments; fuel break construction; and underburning. Connected actions include the use of temporary roads, landing construction, water drafting for dust abatement, and road legacy site treatments. Approximately 3,524 acres of ground disturbance will occur within the 11,810 acre project area.

In early 2017, winter and spring storms, along with a high volume of spring run-off, created conditions that precipitated numerous slides within the LCP drainages of Boulder Creek, Canyon Creek, and Kelsey Creek. The intention of this memo is to provide a post-event update to the existing environment of the LCP and, where necessary, update analysis Indicators.

Within the LCP area, aquatic resources were affected by slides. However, slide-associated impacts – turbidity, increased fine sediment loading, increased large wood, scouring of riparian vegetation – largely originated outside the LCP; and were often initiated from Wilderness locations. For example, the largest known slide/debris flow within the three Project drainages occurred at Maple Falls on Kelsey Creek (**Photo 1**). This event happened within the Marble Mountain Wilderness upon the footprint of the 2014 Happy Camp Complex fire, resulting in extensive channel scour and other impact for at least 0.5 mile of stream. Additional smaller slides were recorded within Kelsey Creek; and Boulder Creek ran turbid multiple times, likely as a result of earth movement of known slide-prone areas within Wilderness.

Photo 1. Channel scour at Maple Falls due to a slide and subsequent debris flow. Location is Marble Mountain Wilderness, outside of Project area.

In contrast, the initiation of new slides or re-activation of existing (known) slides within the LCP boundary was minimal (**Figure 1**). There was a total of about 29 new active features within the project area, with about 15 acres of overlap with proposed commercial treatment units. Modification to treatment units is detailed in **Table 1**. While no units were dropped nor boundary changes made, within impacted units there was the implementation of an equipment buffer from affected areas and exclusion of previously marked trees from harvest. This action is consistent with Best Management Practices and Project Design Features listed in the LCP Environmental Analysis.

1

Many roads throughout the LCP area were affected by the storm events. Where appropriate, these roads are being, or have been, repaired as part of regular Forest road maintenance, separate from the Project proposal. Legacy sites previously identified for inclusion in the LCP were re-evaluated by the District Hydrologist to determine if modification to the Project was necessary. Most legacy sites were found to be minimally or not affected by the storms. The status of five sites was altered to "imminent risk of failure"; and two new locations, with a combined sediment volume risk of 80 cubic yards, were identified. Where appropriate, impacted legacy sites have been stabilized and temporarily repaired. All storm-affected existing and new locations will be addressed through the legacy site process as described in the LCP analysis. The exception is one site, which due to the severity of damage, is expected to be repaired via the Emergency Relief for Federally Owned Roads Program and, thus, be removed from the LCP list.

Alteration of Existing Conditions

Multiple Indicators describing the existing condition were potentially affected as a result of the 2017 storm event. Most changes are expected to be short-term, returning to the pre-storm baseline in a few years. Of the three drainages, Kelsey Creek appears to have been the most affected, likely because of its location within the 2014 Happy Camp Complex footprint. The Indicators to be briefly discussed include: (1) Temperature, (2) Sediment/Substrate, (3) Turbidity, (4) Large Woody Debris, (5) Disturbance History and Regime, and (6) Riparian Reserve. Also see **Tables 2-4** at the end of the document.

Temperature

Extensive scouring at and below Maple Falls within the Marble Mountain Wilderness on Kelsey Creek may cause a temporary increase in downstream summer water temperatures, including within the LCP boundary. Temperatures are expected to remain elevated over historic baseline until such time the riparian sufficiently re-establishes to create effective shade in the affected area. It may require several years of monitoring at the existing site near the mouth of Kelsey Creek to determine the extent of increased temperatures within the anadromous portion of the stream. However, any changes are not expected to be of sufficient magnitude to degrade Kelsey Creek from its current "Properly Functioning" condition.

No extensive channel scour or other riparian impacts are known to have occurred within the Boulder Creek or Canyon Creek drainage. Therefore, the existing temperature regime is not expected to change for these streams.

Sediment/substrate

Since the 2017 storm and run-off event, there has been a visible increase in surface fine sediment composition within the anadromous portion of Kelsey Creek. Because this sediment is believed to primarily originate from slides along the mainstem within the Wilderness, it should therefore be considered part of the natural variation of the system. While there may be a temporary degradation of this Indicator to "Functioning-at-Risk", it is expected that most fine sediment will be exported in the next few years, largely returning the creek to its previous "Properly Functioning" baseline condition.

An increase in fine sediment loading has also been seen in Boulder Creek. The observation is similar to an event in 2014 in that the origin is suspected to be somewhere within the Wilderness boundary and associated with one of several slide-prone areas. As

with Kelsey Creek, these events are likely part of the natural variation of the system when they occur within the Wilderness area; and it is expected that there will be a return to a more coarse sediment baseline in a few years. Of note, Boulder Creek had been moving in that direction since the 2014 event, but recovery has been hindered by 2017 slides.

There has been no notable visible change in fine sediment for Canyon Creek.

While new earth movement was observed within the LCP boundary, none was found to intersect creek mainstems or large tributaries thereof. Therefore, fine sediment from these sources is not considered to be measurably significant to contribute in a cumulative fashion to fines input from existing sources (within or without the Project boundary) or new Wilderness landslides.

Turbidity

Both Kelsey Creek and Boulder Creek had extended periods of turbidity in spring 2017, especially the latter, which was muddy for many weeks. Continued slide movement and settling in the next winter season will probably trigger additional turbidity which will persist longer than the "Properly Functioning" baseline, especially following precipitation events. However, the increase in turbidity is expected to be temporary, lasting no longer than a year or so, with an eventual return to the pre-storm baseline.

No uncharacteristic elevation in turbidity was observed or reported for Canyon Creek.

Large Woody Debris

Due to slides, debris flow scour, and fire-weakened/dead trees falling into the channel over the winter, a large increase in woody debris has been observed in Kelsey Creek. Numerous jams formed (and broke) between Maple Falls and the South Fork Kelsey Creek confluence; and a significant number of debris of all sizes was transported to the anadromous portion of the creek. While the amount of wood, in the professional opinion of the District Fish Biologist, may have increased the baseline to "Functioning-at-Risk" from "Not Properly Functioning", the benefit may be temporary if wood cannot be retained. Winter/spring flows in the next few years have the potential to export wood out of the system. In several years, it is recommended to revisit the condition of Kelsey Creek and determine via wood loading measurements if the long-term baseline can be upgraded.

Significant changes in large wood have not observed in either Boulder Creek or Canyon Creek.

Disturbance History and Regime

Changes to the existing condition of the disturbance regime focuses on the Cumulative Watershed Effects model GEO component (**Table 6**). Neither the ERA nor USLE element of the model are considered to be sensitive to landslides and, therefore, are not included in the update discussion.

The results show no increase in the existing condition GEO risk ratio for the following 7th-field watersheds: Boulder Creek, Deep Creek-Scott River, North Fork Kelsey Creek, South Fork Kelsey Creek, or Upper Canyon Creek. Drainages which did experience an increase include Lower Canyon Creek (by 0.01) and Isinglass-Scott River (by 0.63). A caveat to the risk ratio is that the post-storm GEO baseline only includes new slides identified within the LCP boundary. Slides outside this area have not been sufficiently

assessed at this time for inclusion in the model. However, it is not expected that these non-Project slides are sufficient to move baseline GEO risk over threshold conditions in those watersheds where they occur.

Overall, the disturbance history and regime Indicator as analyzed within the Biological Assessment remains valid. In those drainages where there was an increase in the GEO model, none passed the 1.0 risk threshold of concern; and no drainages passed the 1.0 risk threshold when Project effects were added. The one 7th-field watershed already over the threshold of concern – Deep Creek-Scott River – did not increase its risk rating (1.40) beyond that previously analyzed in the Lovers Canyon Biological Assessment.

Of note for the North Fork Kelsey Creek 7th-field watershed, the landslides and scour event impact to riparian vegetation suggests a temporary shift to "Functioning-at-Risk" due to magnitude of impact. However, the primary effect was within a Wilderness area and as such it can be viewed as part of the natural environment because the slides were not initiated due to human-mediated actions. It is the professional opinion of the District Fish Biologist that a return to the "Properly Functioning" will be warranted in a few years once vegetation re-establishes in scoured areas and the landslides stabilize.

Riparian Reserves

Extensive scouring at and below Maple Falls within the Marble Mountain Wilderness on Kelsey Creek, an estimated distance of at least 0.5 mile, may cause a temporary decrease in Riparian Reserve values within the affected area. Riparian vegetation along mainstem Kelsey Creek within the anadromous portion (i.e., South Fork Kelsey Creek 7th-field watershed) was not affected. Any changes to Riparian Reserves at the larger drainage scale are not of sufficient magnitude to downgrade the Indicator from its current "Functioning-at-Risk" designation, especially as the impact occurred within Wilderness and was not initiated due to human-caused activities. Riparian Reserves are expected to eventually return to their pre-2017 condition as riparian vegetation re-establishes, although the time scale is not known.

No extensive channel scour or other riparian impacts are known to have occurred within the Boulder Creek or Canyon Creek drainage. Therefore, the Riparian Reserves Indicator will not change for these streams.

Determination Summary

In summary, the LCP letter-of-concurrence effects[1] determinations for Coho salmon, Coho Critical Habitat, and Coho/Chinook Essential Fish Habitat will not be altered because -

(1) Actions have been taken within the Project area to minimize additional impact to those slides which intersect commercial harvest units;
(2) Project activities are not expected to hinder or delay the natural trajectory of recovery of LCP creeks to their pre-2017 winter event baseline; and
(3) Effects expected as a result of LCP activities, as analyzed in the Biological Assessment, do not significantly add to the new existing condition baseline established following the 2017 storm and run-off events.

[1] Determinations are "May Affect, Not Likely to Adversely Affect" Coho salmon and Coho Critical Habitat; and "Will Not Adversely Affect" Coho/Chinook Essential Fish Habitat.

Table 1. Commercial harvest units affected by 2017 storm damage, including actions to be taken to minimize impacts to natural resources. Units inspected and information compiled by KNF Forest Geologist.

Unit Number	Activity	Active Feature Information and Proposed Modification
526-030	Ground based harvest	Rotational slide that initiated a debris flow in the northeast portion of the unit. Tractor and mechanical harvesters will be excluded from the unstable lands (PDF, WS-4); marked trees within unstable lands will be blacked out, no trees will be removed from the new active feature.
526-031a	Ground based harvest	Large landslide, tractor and mechanical harvesters will be excluded from the unstable lands (PDF, WS-4); marked trees will be blacked out, no trees will be removed from the new active feature.
526-076	Ground based harvest	New landslide in the northeast portion of the unit. Tractor and mechanical harvesters will be excluded from unstable lands (PDF, WS-4); marked trees will be blacked out, no trees will be removed from the new active feature.
526-085	Skyline harvest	Two new landslides and one debris flow occurred within the unit. No cable corridors will occur within any landslide axis (PDF, WS-3). No machinery will occur on the active features (PDF, WS-4); marked trees will be blacked out, no trees will be removed from the active features.
526-089	Ground based harvest	Two new landslides within the unit. Tractor and mechanical harvesters will be excluded from unstable lands (PDF, WS-4); marked trees will be blacked out, no trees will be removed from the new active feature.
526-090b	Skyline harvest	Large earth flow that has cracked and dropped the 44N41 road. No cable corridors will occur within any landslide axis (PDF, WS-3). No machinery will occur on the active features (PDF, WS-4); marked trees will be blacked out, no trees will be removed from the active features.
526-097	Skyline harvest	New large active feature containing multiple springs. No cable corridors will occur within any landslide axis (PDF, WS-3). No machinery will occur on the active features (PDF, WS-4); marked trees will be blacked out, no trees will be removed from the active features.
526-110	Skyline harvest	Two new landslides within the unit. No cable corridors will occur within any landslide axis (PDF, WS-3). No machinery will occur on the active features (PDF, WS-4); marked trees will be blacked out, no trees will be removed from the active features.
526-197	Endline harvest	Large translational landslide that initiated debris flow below onto the edge of the unit below (526-146). No cable corridors will occur within any landslide axis (PDF, WS-3). No machinery will occur on the active features (PDF, WS-4); marked trees will be blacked out, no trees will be removed from the active features.

Table 2. Table of Pathway and Indicators for 7th-field Watershed: Boulder Creek (for Boulder Creek). See Appendix D of the Biological Assessment for legend and references.

DIAGNOSTIC OR PATHWAY and INDICATOR	Environmental Baseline			Effects of the Action		
	PROPERLY FUNCTIONING	FUNCTIONING - AT RISK	NOT PROP. FUNCT.	RESTORE	MAINTAIN	DEGRADE
HABITAT:						
Habitat Quality: Temperature	WQ 2012; Temps-Boulder				X	
Suspended Sediment - Intergravel DO/Turbidity[1]	PJ; CWE				X	
Chemical Contamination/ Nutrients	PJ				X	
Habitat Access: Physical Barriers	PJ; CDFW 2015; FishPass 2001[2]				X	
Habitat Elements: Substrate Character and Embeddedness[1]	CWE; Sed 2013				X	
Large Woody Debris	N/A for streams less than 3rd order; however, not properly functioning (USFS 2015b)				X	
Pool Frequency and Quality	USFS 2013b				X	
Large Pools						
Off-channel Habitat	N/A - Not present					
Refugia	PJ				X	
Channel Cond & Dyn Average Wetted Width/Maximum Depth	PJ				X	
Streambank Condition	PJ				X	
Floodplain Connectivity	PJ				X	
Flow/Hydrology Change in Peak/Base Flows	PJ; CWE				X	
Increase in Drainage Network	PJ				X	
Watershed Conditions: Road Density & Location	PJ; GIS				X	
Disturbance History & Regime	PJ; CWE 2015				X	
Riparian Reserves - Northwest Forest Plan		PJ; Coho-Sct 2014			X	
SPECIES AND HABITAT:						
Species and Habitat: Summary/Integration of all Species and Habitat Indicators		X			X	
	Boulder Creek does not directly support anadromous species. Salmonids utilize the cool-water outflow as thermal refugia during the summer. See other matrices for general basin-wide conditions for Coho, Chinook, and steelhead.			See BA or Aquatic Resource Report for an Indicator effects summary. The Env. Conseq. section also describes effects to fish and their habitat. Project will not cause adverse effects.		

[1]Short-term, post-2017 storm event degradation in current condition may occur for several Indicators - turbidity, substrate character. Magnitude of impact may or may not be sufficient to require a temporary change in functionality; and these Indicators are expected to return to more typical and expected condition within a season or two. Boulder Creek has a history of Wilderness slides that will affect the channel outside the Wilderness boundary; impact from last known event in 2014 was largely cleared prior to 2017 event. The downstream impact from Wilderness slides are considered to be within range of natural variability for these two indicators.

[2]Culvert on Forest Road 44N45 upgraded in 2005 to allow unrestricted aquatics passage.

Table 3. Table of Pathway and Indicators for 7th-field Watershed: Lower Canyon Creek (for Canyon Creek). See Appendix D of the Biological Assessment for legend and references.

DIAGNOSTIC OR PATHWAY and INDICATOR	Environmental Baseline			Effects of the Action		
	PROPERLY FUNCTIONING	FUNCTIONING - AT RISK	NOT PROP. FUNCT.	RESTORE	MAINTAIN	DEGRADE
HABITAT:						
Habitat Quality: Temperature	WQ 2012; Temps-Canyon				X	
Suspended Sediment - Intergravel DO/Turbidity	PJ; CWE; Sed 2016				X	
Chemical Contamination/ Nutrients	PJ				X	
Habitat Access: Physical Barriers	PJ; CDFW 2015; FishPass 2001				X	
Habitat Elements: Substrate Character and Embeddedness	CWE; Sed 2013; WA 2000; Canyon 2005, 1997				X	
Large Woody Debris			PJ; WA 2000		X	
Pool Frequency and Quality	USFS 2013a				X	
Large Pools						
Off-channel Habitat	PJ				X	
Refugia	PJ				X	
Channel Cond & Dyn Average Wetted Width/Maximum Depth	PJ; Canyon 2005, 1999, 1998, 1997				X	
Streambank Condition	PJ				X	
Floodplain Connectivity	PJ				X	
Flow/Hydrology Change in Peak/Base Flows	PJ; CWE				X	
Increase in Drainage Network	PJ				X	
Watershed Conditions: Road Density & Location		WA 2000; GIS			X	
Disturbance History & Regime[1]	PJ; CWE				X	
Riparian Reserves - Northwest Forest Plan		PJ; Coho-Sct 2014; WA 2000			X	
SPECIES AND HABITAT:						
Species and Habitat: Summary/Integration of all Species and Habitat Indicators		X			X	
	Due to lack of data, specific trend for anadromous fish in this subdrainage is unknown. However, some sources are available to examine the general Scott River condition. (1) Screw trap data since 2000 suggests a steady to upward trend for Chinook smolts and steady to slightly down for steelhead smolts (CDFW 2014). (2) Run size estimate for spawning Chinook since 1978 is steady to slightly down (CDFW 2015). Recent trends for Coho are unclear, but overall the run is considered to be depressed. See Life History section for additional information			See BA or Aquatic Resource Report for an Indicator effects summary. The Env. Conseq. section also describes effects to fish and their habitat. Project will not cause adverse effects.		

[1]Short-term, post-2017 storm event degradation in current condition may occur for the following Indicators - disturbance history/regime. Magnitude of impact may or may not be sufficient to require a temporary change in functionality.

Table 4. Table of Pathway and Indicators for 7th-field Watershed: SF Kelsey Creek (for mainstem Kelsey Creek). See Appendix D of the Biological Assessment for legend and references.

DIAGNOSTIC OR PATHWAY and INDICATOR	Environmental Baseline			Effects of the Action		
	PROPERLY FUNCTIONING	FUNCTIONING - AT RISK	NOT PROP. FUNCT.	RESTORE	MAINTAIN	DEGRADE
HABITAT:						
Habitat Quality Temperature[1]	WQ 2012; Temps-Kelsey				X	
Suspended Sediment - Intergravel DO/Turbidity[1]	PJ; CWE; Sed 2016				X	
Chemical Contamination/ Nutrients	PJ				X	
Habitat Access Physical Barriers	PJ; CDFW 2015; FishPass 2001[2]				X	
Habitat Elements Substrate Character and Embeddedness[1]	CWE; USFS 2015a; Sed 2013; WA 2000; Kelsey 2005, 1997				X	
Large Woody Debris[1]			USFS 2015a; WA 2000; Kelsey 1997		X	
Pool Frequency and Quality		PJ; USFS 2015a; WA 2000; Kelsey 1997, 1989			X	
Large Pools						
Off-channel Habitat	PJ				X	
Refugia	PJ				X	
Channel Cond & Dyn Average Wetted Width/Maximum Depth	PJ; USFS 2015a				X	
Streambank Condition	USFS 2015a				X	
Floodplain Connectivity	PJ				X	
Flow/Hydrology Change in Peak/Base Flows	PJ; CWE				X	
Increase in Drainage Network		PJ			X	
Watershed Conditions Road Density & Location		PJ; WA 2000; GIS			X	
Disturbance History & Regime[1]	PJ; CWE				X	
Riparian Reserves - Northwest Forest Plan[1]		PJ; Coho-Sct 2014; WA 2000			X	
SPECIES AND HABITAT:						
Species and Habitat: Summary/Integration of all Species and Habitat Indicators		X			X	
	Due to lack of data, specific trend for anadromous fish in this subdrainage is unknown. However, some sources are available to examine the general Scott River condition. (1) Screw trap data since 2000 suggests a steady to upward trend for Chinook smolts and steady to slightly down for steelhead smolts (CDFW 2014). (2) Run size estimate for spawning Chinook since 1978 is steady to slightly down (CDFW 2015). Recent trends for Coho are unclear, but overall the run is considered to be depressed. See Life History section for additional information			See BA or Aquatic Resource Report for an Indicator effects summary. The Env. Conseq. section also describes effects to fish and their habitat. Project will not cause adverse effects.		

[1]Short-term, post-2017 storm event degradation in current condition may occur for several Indicators - temperature, turbidity, substrate character, disturbance history/regime. Magnitude of impact may or may not be sufficient to require a temporary change in functionality; and these Indicators are expected to return to more typical and expected condition within a season or two. The large woody debris Indicator has the potential to be upgraded, but will need to be reassessed in a couple of years to determine if observed increase in wood loading is long-term or temporary.

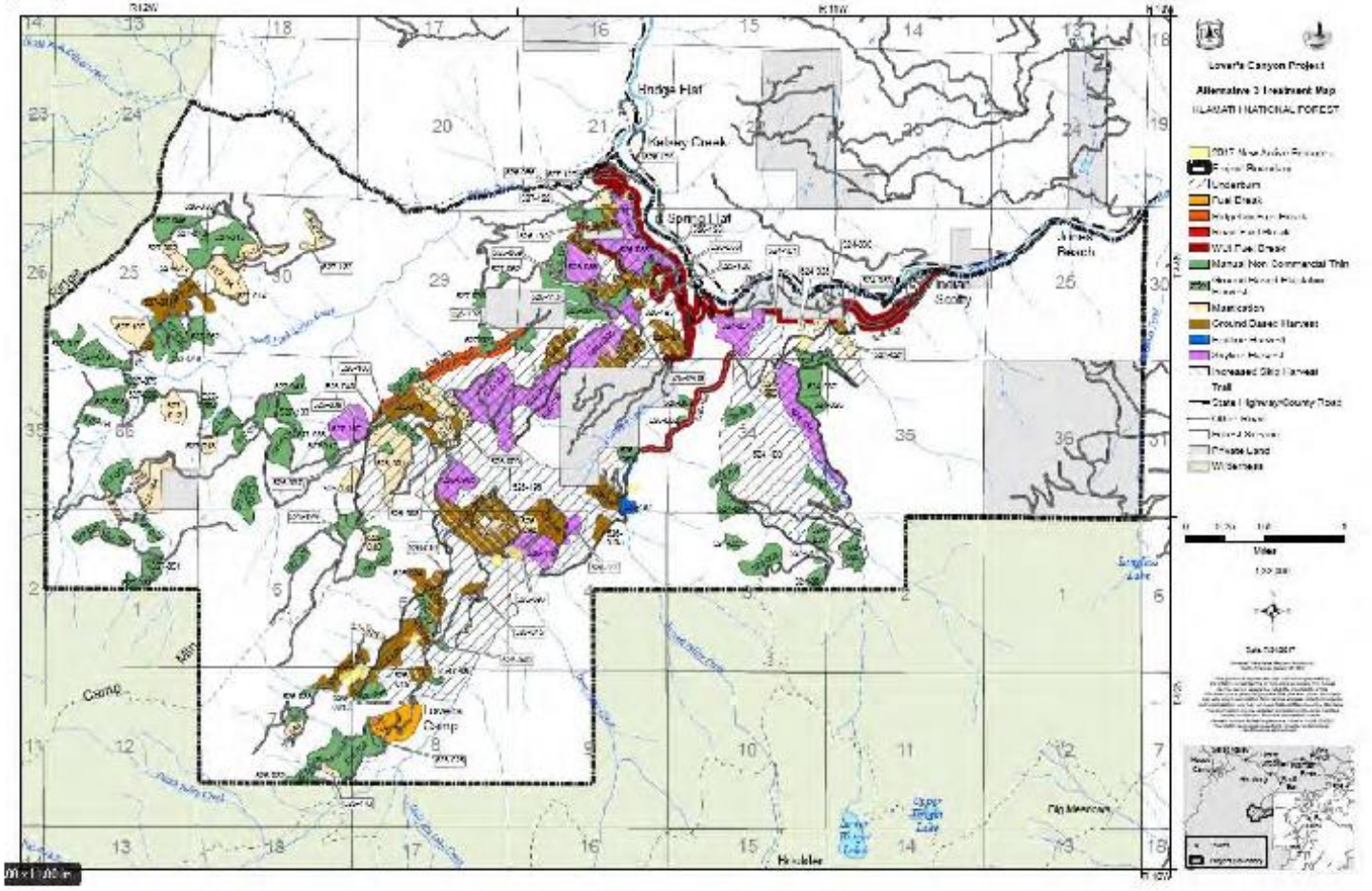
[2]Barriers in Kelsey Creek drainage are on SF Kelsey Creek, outside range of anadromy

Table 5. Baseline (pre- and post-2017 slides) and post-Project cumulative watershed effects. Underlined text are values changed due to the winter/spring storm event landslides. Text in bold highlight values over the 1.0 threshold risk value.

Watershed	Acres	Baseline (pre-2017 slides)	Baseline[1] (post-2017 slides)	Post-Project
		GEO Risk	GEO Risk	GEO Risk
7th-Field Watershed(s)				
Boulder Creek	2693	0.11	0.11	0.11
Deep Creek-Scott River	3798	**1.37**	**1.37**	**1.40**
Isinglass Creek - Scott River	5950	0.12	<u>0.75</u>	<u>0.75</u>
Lower Canyon Creek	6535	0.36	<u>0.37</u>	<u>0.44</u>
Upper Canyon Creek	5179	0.06	0.06	0.06
NF Kelsey Creek	5177	0.39	0.39	0.39
SF Kelsey Creek	6199	0.30	0.30	0.31

[1]Only new slides within, or immediately adjacent to, the Lovers Camp Project boundary were included in the new GEO baseline. Slides within Wilderness areas or otherwise remote to the Project area have not been sufficiently assessed at this time for inclusion in the model. However, it is not expected that these non-Project slides are sufficient to move GEO risk over threshold conditions.

Figure 1. Map of Lovers Camp Project area, including new slides (within the Project boundary) identified following 2017 storm and spring run-off events.



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